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EARCH INSTITUTE, CO

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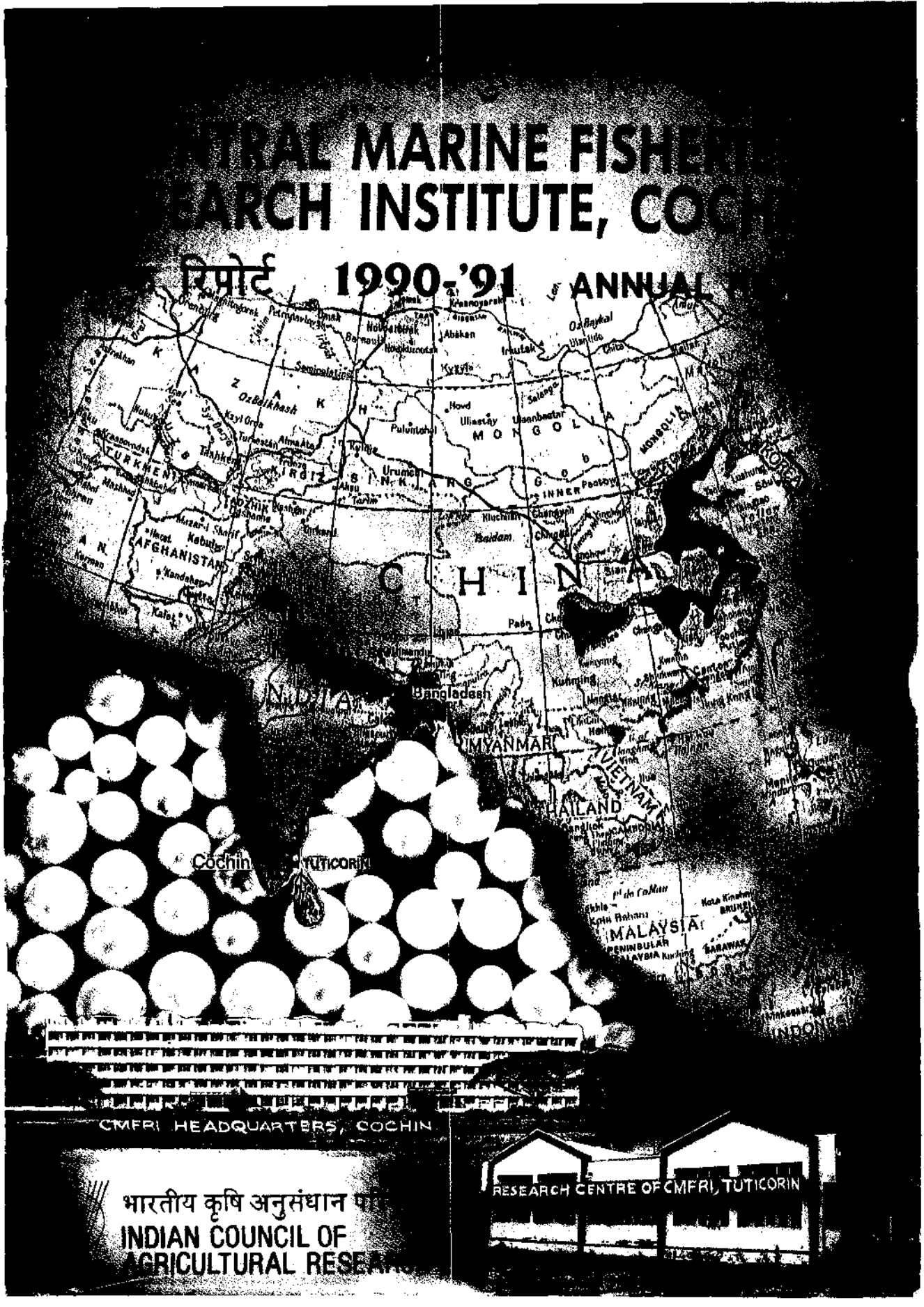

CMFRI HEADQUARTERS, COCHIN

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INDIAN COUNCIL OF
AGRICULTURAL RESEA

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE, COCHIN

Annual Report 1990 - '91

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Issued by

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ANNUAL REPORT 1990-'91

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Annual Report 1990-'91

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE

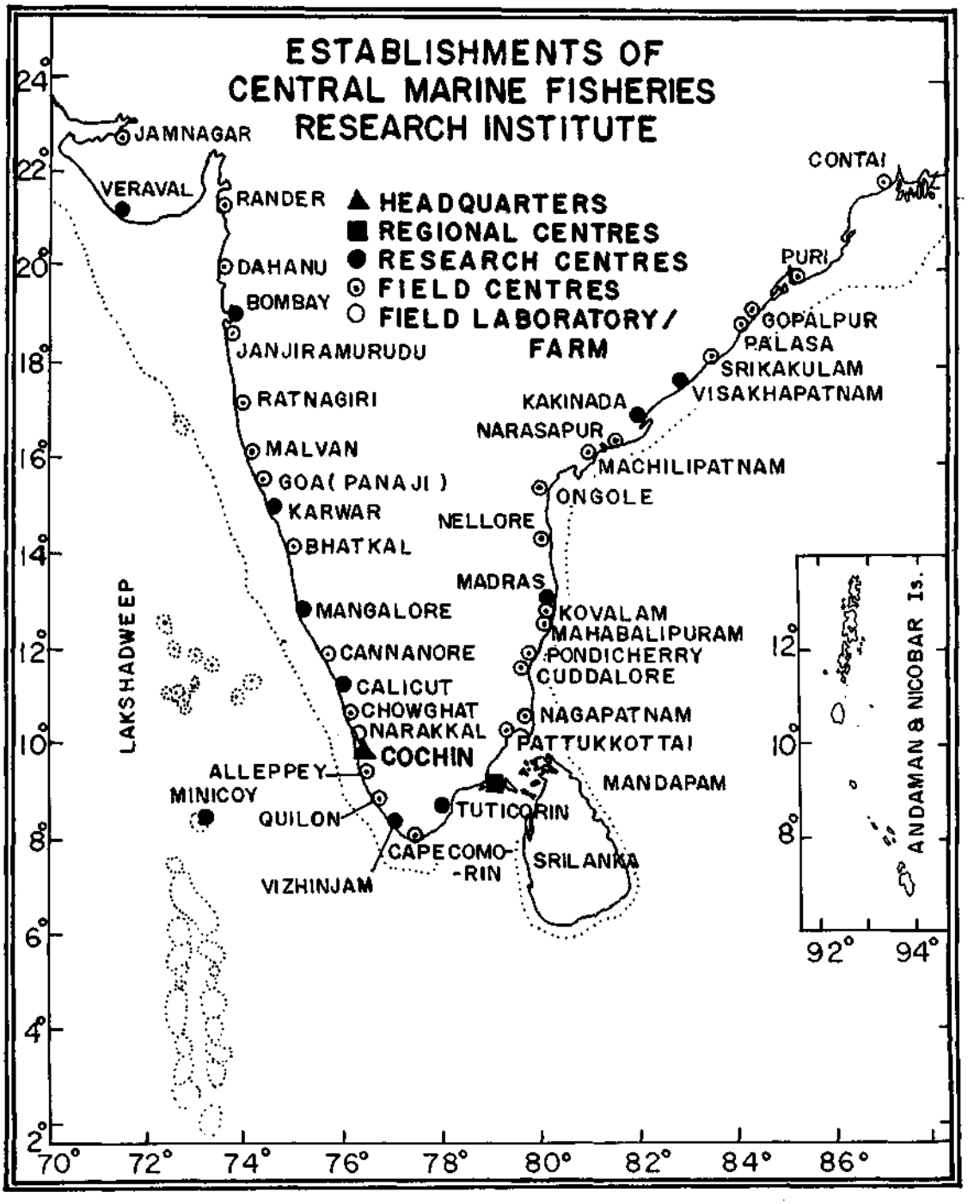
Brief History, Mandate and Organisational set up

The Central Marine Fisheries Research Institute was established in 1947 by the Ministry of Agriculture and Irrigation and subsequently brought under the Indian Council of Agricultural Research in 1967. The Institute headquarters is located at Cochin and its Regional Centre at Mandapam Camp. The 11 Research Centres and 28 Field Centres are situated along the east and west coasts.

The Institute has been actively conducting research both in the capture and the culture fisheries and has contributed significantly to the overall development of marine fisheries in the country. The Institute has the mandate to conduct Research for assessing and monitoring the expolited fisheries resources leading to rational expolitation,conservation and management; to assess the under exploited marine fisheries resources of the Exclusive Economic Zone; to understand the fluctuations in abundance of marine fisheries resources in relation to changes in the environment by conducting vessel based programmes; to develop suitable mariculture technologies for finfish and shellfish production; to conduct transfer of technology; short term and long term training and post-graduate programmes.

The Institute implements its research programmes through the following eight major Divisions: Fishery Resources Assessment Division; Pelagic Fisheries Division; Demersal Fisheries Division; Molluscan Fisheries Division; Crustacean Fisheries Division; Fishery Environment Management Division; Physiology, Nutrition and Pathology Division and Fishery Economics and Extension Division.

The Post-Graduate Programme in Mariculture affiliated to the Cochin University of Science & Technology conducts M.Sc. and Ph.D. programmes in Mariculture. The Library and Documentation Section provides reference facilities to the staff and students of the Institute and to visitors both within and outside the country. It is also responsible for bringing out the Institute's publications. The Krishi Vigyan Kendra and Trainers' Training Centre at Narakkal are involved with extension programmes and imparting training in capture and culture fisheries.


ESTABLISHMENTS OF
CENTRAL MARINE FISHERIES
RESEARCH INSTITUTE
HEADQUARTERS
REGIONAL CENTRES
RESEARCH CENTRES
FIELD CENTRES
FIELD LABORATORY/
FARM
JAMNAGAR
VERAVAL
RANDER
DAHANU
BOMBAY
JANJIRAMURUDU
RATNAGIRI
MALVAN
GOA(PANAJI)
KARWAR
BHATKAL
MANGALORE
CANNANORE
CALICUT
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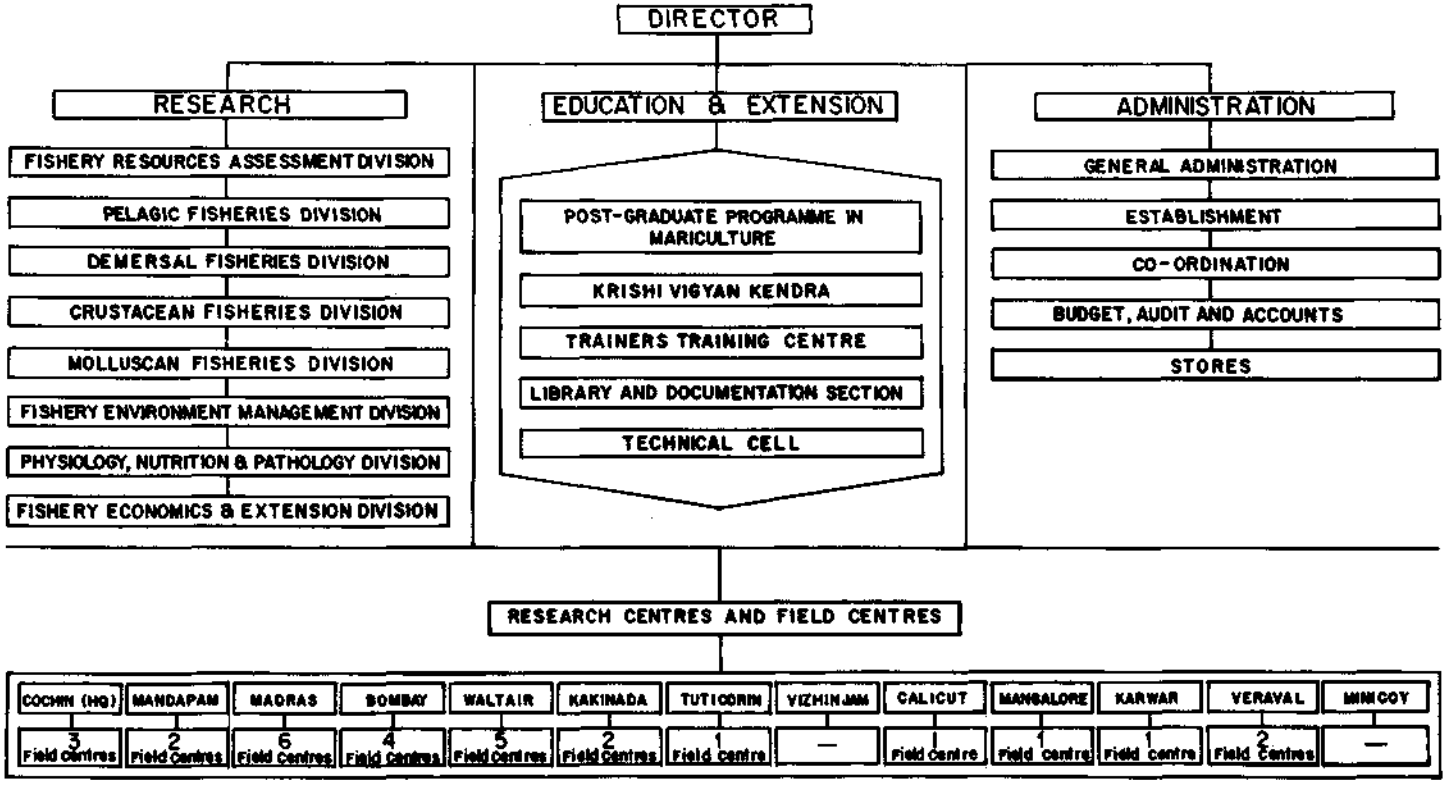
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE (ICAR)
ORGANISATIONAL CHART



INTRODUCTION

The integrated research projects involving monitoring of fishing activities, environmental parameters, economics and extension were continued this year. The projects were taken up with a view to assess the stocks of the major groups and suggest measures for better management of the resources exploited by the major gears from the Exclusive Economic Zone. Stock assessment of 40 species of finfishes and shellfishes was initiated and the consolidated reports of the results are being finalised. In addition, the assessment of the total marine fish production, fishery and biology of important groups/species contributing to the fishery in the various gears; the environmental factors affecting the fishery, economics, etc., were continued to be monitored at the important fishing centres. Basic researches on ecology, fishery biology, physiology, pathology, genetics, etc., were also taken up by the scientists and research fellows of the Institute.

Marine Fish Production

The marine fish production in India during 1990 has been provisionally estimated at 2.16 million t against 2.23 million t of 1989, showing a decrease of 68,000 t (3%). The production from the west coast showed a decline of 6.9% whereas the production from the east coast increased by 10.2%. The decline was mainly due to reduced landings of mackerel by 1,07,000 t and oil sardine by 18,000 t. The landings by mechanised units accounted for 85% of the total catch of which mechanised fishing units (trawlers and purse seiners) accounted for 49% and units with mechanised propulsion the remaining 36%.

Pelagic resources

The pelagic group of fishes with a landing of 12,14,000 t comprised 56% of the total marine landings. As compared to 1989, the catch decreased by 1,34,000 t (10%). Steep decline in the landings of mackerel, oil sardine and whitebaits was noticed during the year. However, other important pelagic resources like the Bombayduck, carangids, ribbonfishes and tunas showed a marginal increase ranging from 6,000 t 10,000 t. At Lakshadweep, the pole and line continued to be the major gear operated for tuna fishing and landed 97% of the tuna catch. Skipjack formed the most dominant tuna species. The availability of tuna live baits further declined and artificial baits made of synthetic materials were extensively used in the pole and line fishery.

Demersal resources

The landings of the demersal resources this year was estimated at 9,48, 271 t, an increase of 66,000 t (7.5%) over that of 1989. The landings by small mechanised trawlers (14 m and below) amounted to 8,71,000 t. Among finfishes, perches contributed 1,21,000 t, an increase of 18,000 t over that of 1989. Threadfin bream was the most dominant among perches and comprised 75% of the landings. Landings of croakers and silverbellies also showed an increase this year.

Crustacean resources

The crustacean landings showed a steep increase during the year. The catch of both penaeid (1,65,000 t) as well as non-penaeid (80,000 t) prawns registered an increase of 18,000 t and 3,000 t respectively over that of 1989. The increase was mainly observed in the north-west region. Prawns with a landing of 1,67,000 t formed the most abundant group (19%) in the catch landed by small trawlers. At Sakthikulangara (south-west coast), the penaeid prawn landings showed a marked increase of 68% over that of the previous year. The increase was mainly due to the increased landings of *Parapenaeopsis stylifera* and *Trachypenaeus* spp.

Molluscan resources

The cephalopod landings showed a marginal increase of 2,000 t from 54,000 t of 1989. The increase was mainly observed from the south-east region. *Anadara granosa, Meretrix casta, M. meretrix* and *Paphia malabarica* contributed to the clam fishery at Kakinada where the total clam production has been estimated at 2,947 t. The clam population at Pulicat Lake was adversely affected by the dredging operations carried out by the Ennore Thermal Station and mass mortality of green mussels was observed in the Ennore Estuary due to inflow of sewage and other pollutants.

Environmental studies

Important hydrographic parameters like the temperature, salinity, dissolved oxygen, nutrients, primary production, secondary production, bacterial count, etc. of the inshore fishing grounds were monitored at all important centres. SST data based on satellite imageries were also received from Space Application Centre. The pollution along the inshore area was also monitored. Heavy metal levels estimated in different marine organisms collected from Cochin showed high levels in bivalves followed by crabs, prawns and fishes. However, the metal levels detected were below the levels recommended for seafood export. Mussels reared near the discharge point of a caustic soda plant at Karwar showed higher concentration of Copper, Zinc, Cadmium and Lead in their tissue.

Survey of coral reef areas in the Gulf of Mannar which were destroyed due to quarrying has showed insignficiant recolonisation even after 25 years.

Physiology, Nutrition, Pathology and Genetics

Experiments on cryopreservation of *Liza parsia* sperms have indicated that speedy movements of the sperms could be preserved upto 30-36 hours when 10% DMSO combined with buffer b was used as a cryoprotectant at -10°C. The staining responses of the neurosecretory cells present in the eyestalk, brain and thoracic ganglia of *Parapenaeopsis stylifera* belonging to different size groups were studied to find out the influence of the various endocrinological factors on maturation.

Most of the feeds prepared in the farmsteads by local prawn farmers of Nellore (Andhra Pradesh) without any technical guidance had a high feed conversion ratio ranging from 3.2 to 4.8. Nutrient imbalance, improper processing, inadequate binding and unscientific feeding practices were attributed to the poor feed conversion ratio. Technical advice was rendered to the farmers on various aspects of scientific farming so as to increase production. Farm trials of low cost compounded feeds developed for selected species of prawns were initiated in six ponds.

Black spot and black gill disease observed in *Penaeus monodon* resulted in ulceration of the chitinous exoskeleton. The malady could be completely cured in 15 days by incorporating tetracycline (11 g/50 kg of feed) in the daily diet and improving hygiene. *Vibrio alginolyticus* infection also could be erradicated by inclusion of oxytetracycline in the feed.

Zymogram patterns of five enzyme systems in *Rastrelliger kanagurta* populations were detected using disc gel electrophoresis. Of these, EST, G6-PD and ADH exhibited polymorphism. Gene frequency values for first esterate locus alone differed between Cochin and Calicut populations.

Fishery Economics

The gross revenue per day of purse seine operation at Cochin Fisheries Harbour amounted to Rs. 8,500/-. The expenditure including fixed cost was worked out at Rs. 6,891/- leaving a net profit of Rs. 1,609/- per day of operation. With 120 fishing days during the year, the annual net profit of a purse seine unit came about Rs. 1,93,080/-. The economic performance of small trawlers at Cochin Fisheries Harbour showed a better trend as compared to earlier years. On an average a trawl unit earned a gross income of Rs. 3,000/- per day of operation. The operating cost was worked out at Rs. 1,900/- per day. After deducting all costs from the annual revenue, the annual net profit per unit was worked out at Rs. 92,700/-.

Mariculture

In the marine prawn hatchery at Mandapam Camp, 1.16 million post larvae-I of *Penaeus semisulcatus* were produced. The seed produced were used for sea ranching and for conducting culture experiments in the farms belonging to the Tamil Nadu State Government. Some post larvae were grown to juvenile stage and these were tagged and released into the sea. Tagged prawns were recovered from the commercial catches from the depth of 4.5 to 7 fathoms indicating that the hatchery reared prawns when released into the open sea, contribute to the fishery of that area. Hatchery produced seed of *Crassostrea madrasensis* was reared in the coastal pond and then in the farms using different culture methods. Highest survival rate of 99.6% was obtained in the box culture method. The hatchery produced seed (10 to 15 mm) was also supplied to the Department of Fisheries, Government of Gujarat. The seed was successfully transported by road and air from Tuticorin to Sikka in 39 hours with 95% survival. Seed of the pearl oyster *Pinctada fucata* produced in the hatchery was sea-rached over the pearl banks off Tuticorin and those of the clam, *Paphia malabarica* in the Korampallam Creek and Pulicat Lake. Egg capsules of chanks were reared in the laboratory and the baby chanks having an initial length of 17 mm grew to 34 mm in a period of five months.

The production from artificial reefs constructed off Valiathura at Vizhinjam, two years ago, has increased to 34.3 t. The increasing trend in the fish and cuttlefish catches has encouraged the construction of several more reefs. Rock fishes like *Epinephelus* liked to keep physical contact with hard surfaces and so concrete structures are preferred over tyre modules.

Vessel-based Programmes

FORV *Sagar Sampada* made 17 research cruises off the south-east and south-west coasts of India, around the Andaman and Nicobar islands and the sea around Lakshadweep. The demersal trawls operated on board landed huge quantities of threadfin breams off the south-west coast. A special survey of four cruises was conducted during the monsoon season (June-August) along the Kerala coast to study the movement of 'Karikkadi'. The survey has confirmed the earlier findings that 'Karikkadi' moved as deep as 80 m. During March '91 a special cruise undertaken to study the impact of oil spill, as a result of Gulf war, on the biota off west coast of India, has revealed the absence of oil pollution in the region during the study period.

The R. V. *Cadalmins* stationed at Headquarters and Research Centres monitored the environmental parameters in the inshore waters.

Education, Training and Transfer of Technology

An International training programme in Pearl Oyster Farming and Pearl Culture was conducted by the Institute at Tuticorin Research Centre during February '91. Participants from ten countries were given theoretical and practical training on various aspects of pearl oyster farming and pearl culture.

Six Senior Research Fellows were awarded Ph.D. Degrees by the Cochin University of Science and Technology. The Junior Research Fellows of the 10th and 11th batches are progressing well.

The Krishi Vigyan Kendra conducted 54 courses and trained a total 1,021 practicing farmers, youths and farm women. Demonstration of various aspects of prawn farming and other allied aspects were also taken up. The Trainers' Training Centre organised training courses on prawn farming, hatchery production of prawn seeds, seaweed culture, post harvest technology and SCUBA diving.

(P. S. B. R. JAMES)
Director

COMMITTEES

MANAGEMENT COMMITTEE

1. The Director, Central Marine Fisheries Research Institute, Cochin. : Chairman

2. Director of Fisheries, Dept. of Fisheries and Ports, Govt. of Kerala, Trivandrum (Kerala). : Member

3. Director of Fisheries, Dept. of Fisheries, Govt. of Tamil Nadu, Madras. : Member

4. The Dean, College of Fisheries, Kerala Agricultural University, Panangad, Cochin. : Member

5. i) Mr. Subramanium, Chairman, National Fisheries Advisory Board, Madras. : Member

   ii) Shri Subey Singh, Ex-SDM, 53, Vikas Nagar, Sonepat Road, Rohtak (Haryana). : Member

6. i) Dr. P. Vedavyasa Rao, Principal Scientist, CMFRI, Mangalore. : Member

   ii) Dr. K. Satyanarayana Rao, Principal Scientist, CMFRI, Madras. : Member

   iii) Dr. P. S. Kuriakose, Scientist (S-3), CMFRI, Calicut. : Member

   iv) Shri P. Sam Bennet, Scientist (Selection Grade), CMFRI, Tuticorin. : Member

7. Dr. K. Radhakrishna, ADG (Marine Fisheries), ICAR, Krishi Bhavan, New Delhi. : Member

8. Finance & Accounts Officer, Central Institute of Fisheries Technology, Cochin. : Member

9. Administrative Officer, CMFRI, Cochin. : Member-Secretary

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2. Shri P. James Abraham, Senior Administrative Officer (Official Side) : Secretary

3. Shri T. V. Asari, Sr. Finance & Accounts Officer : Member

4. Shri K. V. Narayana Rao, Principal Scientist : Member

5. Shri M. S. Rajagopalan, Principal Scientist : Member

6. Dr. P. Bensam, Principal Scientist : Member

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2. Shri V. A. Narayanankutty, Technical Assistant (T-I-3) : Member
3. Shri T. S. Balasubramanian, Technical Assistant (T-II-3) : Member
4. Shri Joseph Andrews, Technical Assistant (T-II-3) : Member

(b) Administrative Group

5. Shri R. Kuppuswamy, Superintendent : Secretary (Staff Side)
6. Shri J. M. Vaz, Superintendent : Member
7. Shri S. Mangalam, Assistant : Member

(c) Supporting Group

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9. Shri K. Muthuramalingam, S. S. Grade III (L. A.) : Member
10. Shri A. P. Sebastian, S. S. Grade III (Peon) : Member

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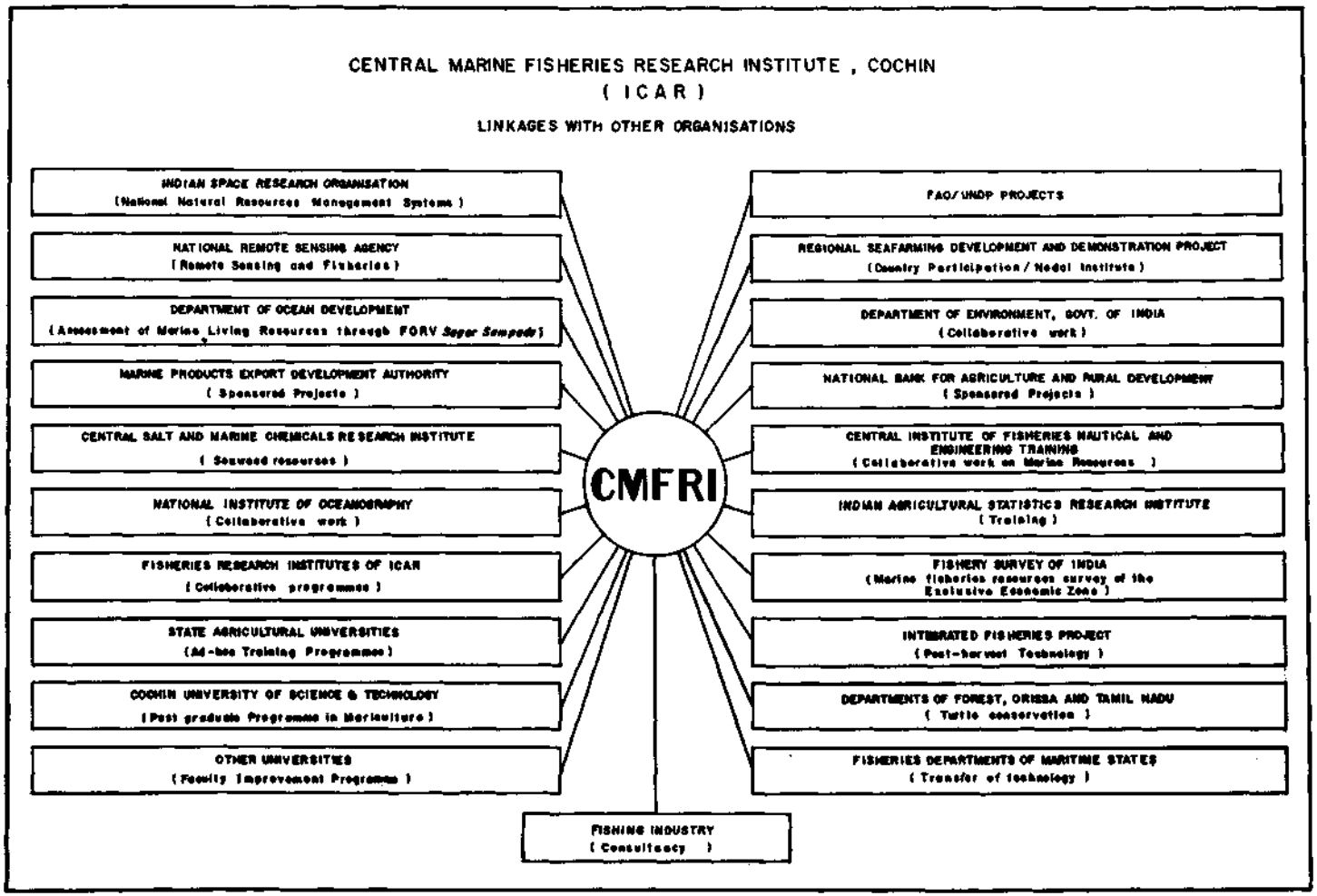
2. Dr. P. Bensam, Principal Scientist - Member
3. Shri P. James Abraham, Sr. Adm. Officer - Member
4. Shri T. V. Asari, Sr. Finance & Accounts Officer - Member
5. Dr. A. Regunathan, Scientist (Selection Grade) - Member
6. Shri M. Abdul Nizar, Jr. Tech. Asst. (T-2) - Member
7. Shri K. Sadanandan, Jr. Clerk - Member
8. Shri G. Soundararajulu, S.S. Grade III (L.A). - Member
9. Shri M. P. Lakshmanan, Asst. Adm. Officer - Member Secretary

Budget/Expenditure statement for the year 1990-'91

St. No.	Account Heads	Non-Plan		Plan	
		Budget Estimates (Rs. in Lakhs)	Expenditure (Rupees)	Budget Estimates (Rs. in (Lakhs)	Expenditure (Rupees)
1	2	3	4	5	6
1.	Establishment Charges	352.00	350,88,484	—	—
2.	Travelling Expenses	10.00	9,76,538	8.00	4,75,664
3.	Other Charges		60,45,548		14,73,930
4.	Equipments	62.40	1,02,843	76.00	21,06,213
5.	Fellowships, Scholarships, Awards, etc.	8.60	7,38,512	6.00	1,82,841
6.	Seminars and Conferences	—	1,02,940	—	—
7.	Grant-in-aid	—	1,19,362	—	—
8.	Works	—	—	—	28,77,739
		433.00	431,74,227	90.00	71,16,387

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE , COCHIN
(ICAR)

LINKAGES WITH OTHER ORGANISATIONS



INTERNATIONAL TRAINING

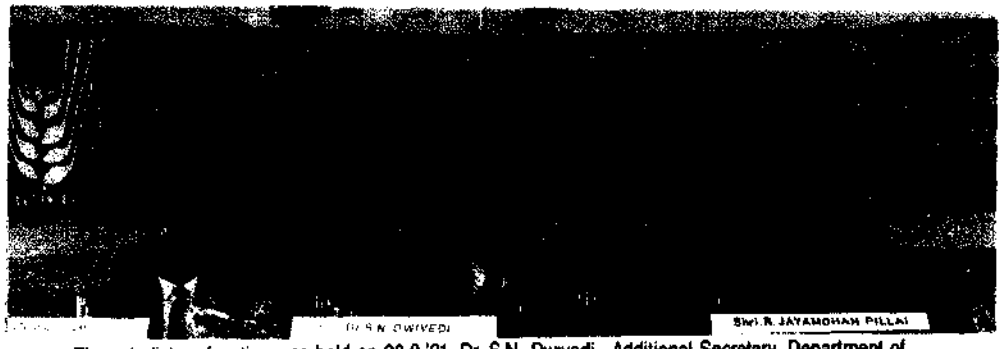
An international training programme in pearl oyster farming and pearl culture was organised by the Institute at the Tuticorin Research Centre in collaboration with the FAO/UNDP Regional Seafarming Development and Demonstration Project, Bangkok. The programme was for a period of one month from 1st to 28th February 1991 and is the first of its kind to be conducted in India. Twentysix participants from ten Countries *viz* ., Bangladesh, People's Republic of China, Malaysia, Philippines, Thailand, Indonesia, Myanmar, Republic of Korea, Vietnam and India attended the training programme.

The training programme was inaugurated by Dr. V. Shanmugasundaram, Vice-Chancellor, Manonmaniam Sundaranar University (second from left) Dr. P.S.B.R. James, Director, C.M.F.R.I. (extreme left) welcomed the gathering and Dr. P.V. Dehadrai, Deputy Director General (Fisheries), ICAR presided (centre). Dr. Chen Foo Yan, Project Co-ordinator, Regional Seafarming Development and Demonstration Project, Bangkok (second from right) and Shri S. Ansar Ali, Collector, Chidambanar District (extreme right). felicitated

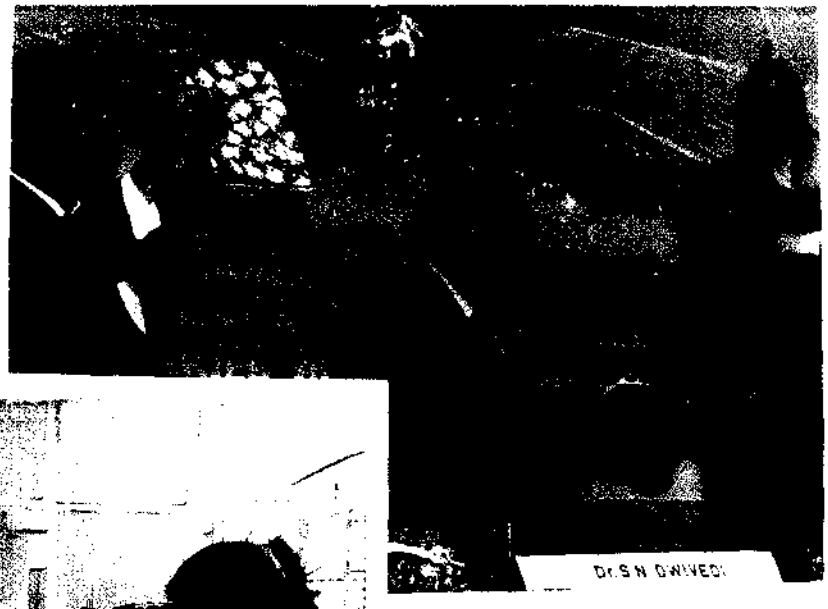
Pearl Oyster surgery in progress.

Fabrication of net-cage

Seminar by Philippine participant.



The valedictory function was held on 28-2-'91. Dr. S.N. Dwivedi, Additional Secretary, Department of Ocean Development (Centre), delivered the valedictory address. Shri Jayamohan Pillai, Chairman, Tuticorin Port Trust (extreme right) presided. Dr. P.S.B.R. James, Director, C.M.F.R.I. (extreme left). welcomed the gathering

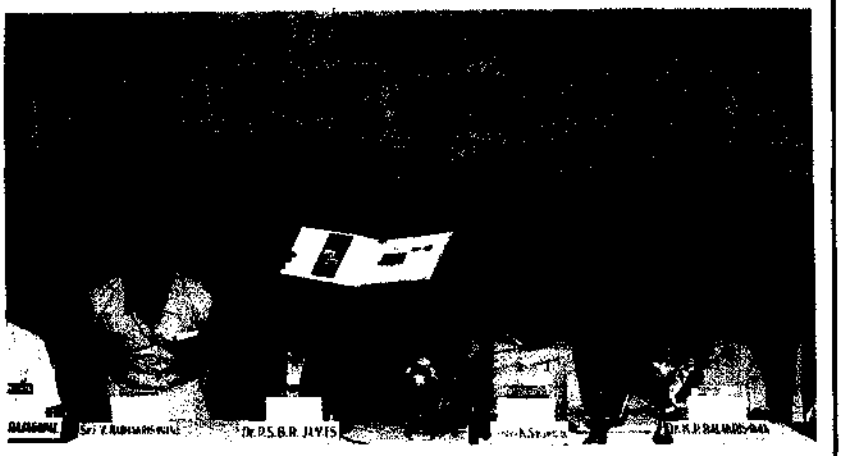


Shri Jayamohan Pillai (right) handing over the first copy of the manual on 'Hatchery Production of Pearl Oyster Spat: *Pinctada fucata*' to Dr. S.N. Dwivedi (Centre)

Dr. S.N. Dwivedi handing over the kit containing tools for tissue grafting and nucleus implantation to a participant from the People's Republic of China.

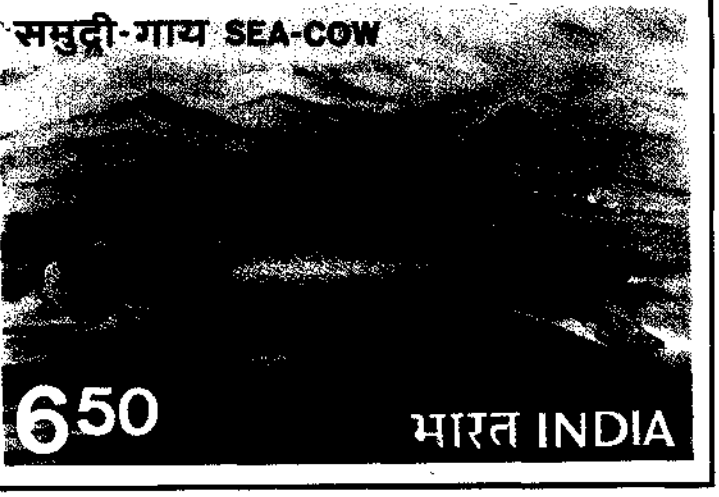
STAMPS ON MARINE MAMMALS

The Postal Department released two stamps on marine mammals at a simple function held at the Conference Hall of the Institute on 4.3.91.



Justice K. Sukumaran (second from right) released the stamps. The Chief Post Master General of Kerala, Shri V. Radhakrishnan (extreme left) presented an album containing the stamps to Dr. P.S.B.R. James, Director, C.M.F.R.I. (second from left) Dr. K.P. Balakrishnan (extreme right) Retd. Professor, School of Environmental studies felicitated.

The stamps depicted the Ganges River Dolphin, *Platanista gangeticus* and the sea cow, *Dugong dugong*



PROGRESS OF RESEARCH

FISHERY RESOURCES ASSESSMENT DIVISION

MARINE FISH PRODUCTION IN INDIA DURING 1990

Marine fish production in India during 1990 has been provisionally estimated at 2.16 million t against 2.23 million t of 1989 showing a decrease of 68,000 t (3.0%). Production from west-coast sustained a reduction of 118,000 t (6.9%) while that from east-coast registered an increase of 51,000 t (10.2%). Pelagic group of fishes registered a decrease of 134,000 t (10.0%) while demersal group of fishes showed an increase of 66,000 t (7.5%) over that of 1989. Among the commercially important fishes, mackerel registered a steep decrease of 107,000 t and oil sardine a reduction of 18,000 t. Penaeid prawns registered an increase of 18,000 t against the landings of 1989.

REGIONWISE PRODUCTION OF MARINE FISHES

A substantial increase of 31,000 t (36.7%) was observed in the north-east region where the landings increased from 84,000 t of 1989 to 115,000 t in 1990. This increase has been mainly contributed by croakers, Bombay duck and penaeid prawns. Croakers registered an increase of 11,000 t in the landings from 10,000 t of 1989. Bombay duck registered an increase of 9,000 t from 4,000 t of 1989 and penaeid prawns 3,000 t from 3,000 t of 1989. The landings in the region accounted for 5.3% of the total production in the country.

South-east region accounted for 20.2% of the total production in the country. Landings in this region increased by 20,000 t (4.9%), with a landing of 437,000 t against 417,000 t of 1989. One of the remarkable features of the landings in south-east coast is the steep increase in the landings of oil sardine by about 17,000 t from 21,000 t of 1989. The landings of lesser sardines, however, witnessed a steep reduction of 13,000 t (24%) compared to 56,000 t of 1989. The landings of mackerel also sustained a decrease of about 6,000 t with a landing of 12,000 t in 1990. Besides oil sardine, other fishes which registered increase in the landings over that of 1989 were penaeid prawns from 25,000 to 29,000 t, scads from 5,000 t to 10,000 t, silver bellies from 39,000 t to 42,000 t and cephalopods from 6,000 t to 8,000 t. Steep reduction was observed in the landings of flying fish in this region from 13,000 t to about 1,000 t in 1990.

Table 1
Regionwise production of marine fishes during 1990 (in tonnes)

Region	Annual Production	Percentage to all India Production
North East (West Bengal and Orissa)	114,556	5.3
South East (Andhra Pradesh, Tamil Nadu and Pondicherry)	437,027	20.2
South West (Kerala, Karnataka and Goa)	907,729	42.0
North West (Maharashtra and Gujarat)	682,619	31.6

Besides, Island Territories contributed 0.9%.

With an annual production of 908,000 t, the south-west region accounted for 42% of the total production of marine fishes in the country. Compared to 1,018,000 t of 1989, the production in 1990 showed a reduction of 110,000 t (10.9%). This decrease has mainly been due to the steep reduction in the landings of Indian mackerel by 96,000 t from 250,000 t of previous year to 154,000 t of 1990. However, it might be observed that 1989 witnessed unusually heavy landings of mackerel in this region. The landings of oil sardine also showed decrease but by a marginal 17,000 t (7%) compared to 238,000 t of 1989, the current year's production maintaining almost the same trend of 1989. Similar decrease has been observed in the landings of *Stolephorus* spp. by 16,000 t from 53,000 t to 37,000 t in 1990. Penaeid prawns sustained a decrease of 12,000 t from 66,000 t of 1989 to 54,000 t in 1990. However, some other commercially important varieties have shown increase in the landings. Thus, coastal tunas increased by 8,000 t (28.3%) from 28,000 t of 1989 to 36,000 t in 1990, carangids from 82,000 t to 92,000 t and perches from 54,000 t of 1989 to 70,000 in 1990, perches showing an increase of 29.2%.

North-west region accounting for 31.6% of the total production in the country witnessed an annual landing of 683,000 t in 1990 registering a marginal decrease of 7,000 t (1.0%) compared to 690,000 t of 1989. The landings of oil sardine which was very high at 19,200 t in 1989 reduced to just 600 t in 1990 reverting back to the trend of previous years. However, the landings of penaeid prawns has shown a remarkable increase of 23,000 t from 52,000 t of 1989 to 75,000 t in 1990. The landings of non- penaeid prawns remained almost at the level of 1989 with a marginal increase of 2,000 t (3.3%) over 74,000 t of 1989. Among other commercially important fishes in the region, Bombay duck remained at the same level as that of 1989 with a marginal increase of 1,000 t from 115,000 t of previous year. Similarly, elasmobranchs also showed an increase of 3,000 t from 20,000 of 1989. However, other important groups registered reduced landings. Thus landings of perches decreased by 2,000 t from 23,000 t of 1989 to 21,000 t of 1990, carangids by 9,000 t from 27,000 t to 18,000 t and pomfrets by 5,000 t from 26,000 t to 21,000 t.

Pelagic group accounted for 56% of the total production and the demersal group 44%.

Table 2
Estimated landings (in tonnes) of Pelagic fishes in India during 1989 and 1990

Name of fish	1989	1990*
CLUPEIDS		
Wolf herring	15173	13409
Oil sardine	278877	261012
Other sardines	83167	77447
Hilsa shad	14556	14243
Other shads	7812	6096
Anchovies	41	110
Coilia	30064	31901
Setipinna	1557	1596
Stolephorus	71020	58682
Thrissina	595	—
Thryssa	22301	22423
Other clupeids	52326	46457
BOMBAY DUCK	120193	130234
HALF BEAKS & FULL BEAKS	2357	2503
FLYING FISHES	13163	941
RIBBON FISHES	65256	74301

CARANGIDS		
Horse mackerel	12454	22121
Scads	58973	67958
Leather-jackets	3482	3160
Other carangids	60700	48548
MACKERELS		
Indian mackerel	290905	184207
Other mackerels	172	195
SEER FISHES		
S. commersoni	21819	15143
S. guttatus	18778	14615
S. lineolatus	60	4
Acanthocybium spp.	327	79
TUNNIES		
E. affinis	26402	32873
Auxis. spp.	7462	6947
K. pelamis	5664	5012
T. tonggol	984	951
Other tunnies	4718	6277
BILL FISHES	1017	1048
BARRACUDAS	8692	11125
MULLETS	9117	9903
UNICORN COD	557	253
MISCELLANEOUS	37189	42225
PELAGIC TOTAL	1347930	1213999

* *Provisional*

Oil sardine: Oil sardine formed 12.1% of the total production of the country and accounted for 21.6% of the pelagic resources. An estimated 261,000 t was landed during 1990 compared to 279,000 t in 1989, thus showing a reduction of 18,000 t (6.4%). The reduction was mainly in south-west coast where the landings reduced from 238,000 t of 1989 to 222,000 t in 1990. 84.4% of the landings came from south-west region. The resource formed 24.4% of the total production in south-west region and 8.9% in south-east region.

Mackerel: Mackerel accounted for 8.5% of the total production in the country. It formed 15.2% of the total pelagic resources exploited. The landings of the resource registered a steep decline of 107,000 t. The reduction has been mainly in south- west region where the landings decreased from 250,000 t by 96,000 t to 154,000 t. A comparable decrease is observed in south-east region and north-west region by about 6,000 t and 5,000 t from 17,000 t and 22,000 t respectively of the previous year. Mackerel formed 17.0% of the total production of the south-west region and accounted for 2.7% of the total fish landings in south-east region and 2.6% in north-west region.

***Stolephorus* spp.:** *Stolephorus* spp. with an annual landing of 59,000 t in 1990 accounted for 2.7% of the total marine fish landings in the country. It formed 4.8% of the total pelagic resources exploited. The landings of this group showed a steep decrease of 12,000 t (17.4%) compared to 71,000 t of 1989. The reduction of the group in south-west region alone was of the order of 16,000 t. However, this registered an increase of 3,000 t in south-east region. 63.2% of the landings was realised from south-west region and 31.8% from south-east region. This formed 4.1% of the total production in south-west region and 4.3% in south-east region.

Bombay duck : Bombay duck with an annual landings of 130,000 t in 1990 formed 6.0% of the total fish landings of the country. This formed 10.8% of the pelagic resources exploited. The landings of the fish registered an increase of 10,000 t in 1990 compared to that in 1989. While the landings remained almost at the same level as that of 1989 in north-west region it registered a steep increase of 8,000 t in north-east region. 89.1% of the landings of this

fish was realised from north-west region and this formed 17.0% of the total production in that region.

Carangids: Carangids accounted for 6.6% of the total fish production and 11.7% of the pelagic resources exploited during 1990. The landings of this group showed marginal increase of 6,000 t (4.6%) in 1990 when the landings increased from 136,000 t of 1989 to 142,000 t. While the landings of this group increased by 7,000 t in south-east region and by 9,000 t in south-west region, it registered a decrease of 9,000 t in north-west region. 64.7% of the landings of this group was realised from south-west region, 20.7% from south-east region, 12.7% from the north-west region and 1.2% from north-east region. This group accounted for 10.1% of the total production of the south-west region, 6.7% in south-east region, 2.6% in north-west region and 1.5% in north-east region.

Ribbonfishes: Ribbonfishes with an annual landing of 74,000 t in 1990 formed 3.4% of the total production and 6.1% of the pelagic resources exploited. The landings of this group registered an increase of 9,000 t in 1990 compared to 65,000 t in 1989. This increase has been mainly contributed by the south- west region (4,000 t) and north-west region (4,000 t) with the landings of 14,000 t and 47,000 t respectively in 1990. North-west region accounted for 63.8% of the total production of this group, north-east region for 7.3%, south-east region for 9.7% and south-west region for 19.1%. This formed 6.9% of the total production in north-west region, 4.7% in north-east region, 1.7% in south-east region and 1.6% in south-west region.

Tunnies: Tunnies registered an increase of about 7,000 t in the landings in 1990 from 45,000 t in 1989. While the landings increased by 8,000 t from 28,000 t of 1989 in south-west region, it showed marginal decrease in north-west and south-east regions. 68.9% of the landings of tunnies came from south-west region, 10.3% from north-west region and 8.8% from south-east region. This accounted for 4.0% of the total landings of south-west region, 1.0% in south-east region and 0.8% in north-west region.

Table 3

Estimated landings (in tonnes) of Demersal fishes in India during 1989 and 1990

Name of fish	1989	1990*
ELASMOBRANCHS		
Sharks	29147	25107
Skates	2278	1625
Rays	19699	23958
EELS	4888	4852
CATFISHES	49794	38230
LIZARD FISHES	20923	24840
PERCHES		
Rock cods	5552	4718
Snappers	3708	2746
Pig-face breams	1943	3855
Threadfin breams	67675	82644
Other perches	23844	26815
GOATFISHES	21811	21655
THREADFINS	7758	6882
CROAKERS	101154	119224
SILVERBELLIES	49337	53876
BIG-JAWED JUMPER	6685	8632
POMFRETS		
Black pomfret	12952	13212
Silver pomfret	29477	26246
Chinese pomfret	447	404

FLAT FISHES		
Halibut	1691	2886
Flounders	142	536
Soles	31552	26465
CRUSTACEANS		
Penaeid prawns	146637	164580
Non-penaeid prawns	76369	79773
Lobsters	1590	2556
Crabs	16191	24243
Stomatopods	69276	65471
MOLLUSCS		
Cephalopods	54487	56237
MISCELLANEOUS	25288	36003
DEMERSAL TOTAL	882295	948271

* *Provisional*

Catfishes: Catfishes with an annual landing of 38,000 t in 1990 registered a decrease of 12,000 t compared to 50,000 t in 1989. The decrease has mainly been observed in south-west region where the landings reduced from 12,000 t in 1989 to about 6,000 t. The landings in north-west region also registered a decrease of 2,000 t from 23,000 t in 1989 to 21,000 t in 1990. Catfishes formed 1.8% of the total production of the country and accounted for 4.0% of the total demersal resources exploited. 56.1% of the total landings of catfishes was realised by north-west region, 18.8% by north-east region, 14.4% by south-west region and 9.8% by south-east region. Catfishes formed 6.3% of the total landings in north-east region, 3.1% in north-west region, and 0.9% in south-east region.

Elasmobranchs: Elasmobranchs did not show any conspicuous change in the landings compared to that of 1989 with an annual production of about 51,000 t. North-west region accounted for 45.6% of the landings of elasmobranchs in the country, south-east region 30.8%, south-west region 17.0% and north-east region 5.3%. Elasmobranchs constituted 3.6% of the total landings in south- east region, 3.4% in north-west region, 2.3% in north-east region and 1.0% in south-west region.

Perches: Perches with an annual production of 121,000 t in 1990 registered an increase of 18,000 t (17.6%) compared to that of 1989. This increase has mainly been observed in south-west coast where the landings increased from 54,000 t of 1989 to 70,000 t of 1990. Among the different species that constituted this group, *Nemipterus* spp. alone showed an increase of 15,000 t in 1990 compared to 68,000 t of previous year. 58.2% of the landings of perches came from south-west region, 21.8% from south-east region, 17.0% from north-west region and 1.9% from north-east region. Perches formed 5.6% of the total fish landings and 12.7% of the demersal group. This group formed 7.7% of the total fish landings in south-west region, 6.0% in south-east region, 3.0% in north-west region and 2.0% in north-east region.

Croakers: Croakers with an annual landing of 119,000 t in 1990 has shown an increase of 18,000 t against 101,000 t of 1989. This increase is mainly observed in north-east region where the landings showed an increase of 11,000 t from 10,000 t of 1989. Similarly the north-west region registered an increase of 4,000 t from 56,000 t of 1989 and south-east region 3,000 t from 18,000 t in 1989. North-west region realised 50.3% of the total landings of croakers, south-east region 18.0%, north-east region 17.9% and south-west region 13.6%.

Silverbellies: The landings of silverbellies showed an increase of 5,000 t in 1990 compared to 49,000 t of 1989. The south-east region alone accounted for

an increase of 3,000 t where the landings were 39,000 t and 42,000 t in 1989 and 1990 respectively. The south-west region also registered an increase of 1,000 t from 8,000 t of 1989. The south-east region accounted for 77.7% of the total landings of silverbellies. South-west region accounted for 17.5% and north-west region for 2.4%. Silverbellies formed 9.6% of the total production of south-east region.

Pomfrets: Pomfrets with an annual landing of 40,000 t showed a decrease of 3,000 t (7.0%) compared to 43,000 t of 1989. The decrease of landings was observed only in north-west region; from 26,000 t of 1989 to 21,000 t in 1990. However, the landings showed increase marginally in other regions. 51.7% of the total landings of pomfrets is realised by north-west region, 20.0% in north-east region, 14.4% in south-west region and 13.8% in south-east region. Pomfrets formed 6.9% of the total production in north-east region and 3.0% in north-west region.

Penaeid Prawns: The landings of penaeid prawns registered an increase of 18,000 t compared to 147,000 t of 1989. The increase was mainly observed in the north-west region by 23,000 t from 52,000 t of 1989 to 75,000 t of 1990. Similarly an increase of 4,000 t from 25,000 t of 1989 was observed in south-east region, and an increase of 3,000 t from 3,000 t of 1989 in north-east region. However, the landings registered a decrease of 12,000 t in south-west region from 66,000 t of 1989. 45.8% of the production of penaeid prawns was contributed by north-west region, 32.8% by south-west region, 17.5% by south-east region and 3.8% by north-east region. This accounted for 7.6% of the total production of the country and 17.3% of the demersal group. The penaeid prawns formed 11.0% of the total production in north- west region, 6.6% in south-east region, 6.0% in south-west region and 5.4% in north-east region.

Non-penaeid Prawns: The landings of non-penaeid prawns showed a marginal increase of 3,000 t (4.5%) compared to 76,000 t in 1989. The increase is mainly contributed by north-west region where the landings increased from 74,000 t of 1989 to 76,000 t in 1990. 95.3% of the production of non-penaeid prawns came from north-west region and 8.4% from north-east region. It formed 11.1% of the total production of north-west region.

Cephalopods: The landings of cephalopods showed a marginal increase of 2,000 t from 54,000 t of 1989. The increase has mainly been observed in south-east region where the landings were 6,100 t and 8,500 t respectively in 1989 and 1990. 47.3% of the total production of the cephalopods came from south-west region, 37.3% from north-west region and 15.2% from south-east region.

Mechanized and Non-mechanized landings

The landings by mechanized units accounted for 85% of the total landings in the country. Landings by units with mechanized fishing (Trawlers and Purse-seiners) accounted for 49% of the total production while units with mechanized propulsion yielded a share of 36%. Contribution from non-mechanized units was 15%. Compared to 1989, the landings by mechanized units did not show any conspicuous change in 1990. The former type of units brought a landing of 1,033,000 t which is less by a marginal 1.5% compared to 1,049,000 t of 1989. Similarly, the landings by the latter type showed a marginal reduction of 0.7% with the landings of 753,000 t in 1989 and 748,000 t

in 1990. However, the landings from non-mechanized units decreased by a remarkable 46,000 t (12.9%) from 354,000 t of 1989.

Effort put in by the units with mechanized fishing in terms of number of operations showed a reduction of 1.8% in 1990 compared to 1,855,000 in 1989 which has resulted in a comparable reduction in the landings by 1.5%. Similarly, the effort put in by the second type of units showed a reduction of 9.5% but has resulted in only a reduction by 0.7% in the landings in 1990 indicating a higher realisation per unit. However, the reduction in effort as well as production were comparable in regard to non-mechanized units; while the former reduced by 12.2% from 8,827,000 in 1989 to 7,753,000 (12.2%) in 1990, the landings by these units reduced by 12.9%.

Table 4 gives the percentage contribution of different types of units to the production in the different regions in the country during 1989 and 1990.

Table 4. Percentage contribution of different types of units

Region	1989			1990		
	I	II	III	I	II	III
North East	22.2	51.2	26.6	29.5	44.4	26.1
South East	42.7	6.8	50.5	47.0	6.6	46.4
South West	54.5	41.5	4.0	48.8	45.8	5.4
North West	46.8	40.6	12.6	55.7	40.0	4.3

It can be seen from the table that in the west coast the contribution from non-mechanized units is relatively very low while the contribution from the units with mechanized fishing is very high in both the years. But in the east coast non- mechanized units still contribute a sizeable share in the production.

Table 5 shows the contribution of different regions in the production of marine fishes by different types of units.

It can be seen from the table below that relatively higher production from the non-mechanized units have come from south-east region whereas the production by mechanized units is maximum in the south-west region. Specifically, the contribution from units with mechanized propulsion is predominantly from south-west region.

The table 6 gives catch, effort and catch per unit effort by different units in 1989 and 1990. It can be seen that while

Table 5. Percentage contribution of three types of units in the regionwise production

Region	1989			1990		
	I	II	III	I	II	III
North East	1.8	5.7	6.3	3.3	6.8	9.7
South East	16.9	3.7	59.5	19.8	3.9	65.7
South West	52.9	56.2	11.5	42.9	55.6	15.8
North West	28.4	34.4	22.7	34.0	33.7	8.8

the CPUE increased in 1990 in the east coast in respect of the production from units with mechanized fishing the same reduced marginally in the west coast. CPUE in respect of units with mechanised propulsion increased in 1990 marginally in all the regions. CPUE in respect of non-mechanized units showed marginal increase in east coast and in south-west coast but in the north-west coast it showed a reduction by 37 kg.

Table 6. Catch, effort and CPUE in 1989 and 1990

		1989			1990		
		A	B	C	A	B	C
North East	(I)	18638	64	289	33828	102	331
	(II)	42882	148	289	50902	150	339
	(III)	22292	629	35	29826	638	47
South East	(I)	177802	538	331	205260	548	374
	(II)	28224	465	61	28904	452	64
	(III)	210762	6062	35	202863	5469	37
South West	(I)	554582	984	564	442917	851	521
	(II)	422992	1456	290	415854	1297	321
	(III)	40830	1408	29	48958	1277	38
North West	(I)	297985	268	1110	351222	320	1099
	(II)	258817	1038	249	252023	913	276
	(III)	80484	729	110	27066	368	73

A: Catch in tonnes, B: Effort, ('000 operation) and C: CPUE (Kgs.)
I: Units powered for fishing; II: Units powered for propulsion
and III: Non-mechanized.

Stock assessment studies of more than 40 groups have been taken up and the team from F. R. A. Division is rendering all the help in this venture. Estimates on parameters such as mortality and growth and the MSY levels are obtained. Suitable management policies needed for reaping the resources at MSY levels are indicated in the reports.

PELAGIC FISHERIES DIVISION

The research work in the Division involved monitoring the landings, species composition of the major groups, biology and population characteristics of dominant species in gillnet (45 mm mesh and above), dolnet, purse seine and pole and line. Preparation of an atlas of pelagic resources and tagging of commercial species of fishes and shellfishes also were taken up.

Investigations on gillnet fisheries (PF/IP/1)

Gillnets were operated almost throughout the year along the east and west coasts except in some areas. They were not operated during June-July off Bombay and Calicut and during June-August off Karnataka. The main season, however, varied at different centres. The annual catches, catch rates (in parenthesis), percentage composition in the total catch in the case of fish groups and main fishery seasons at different centres were as follows : Veraval 6,473 t (174 kg) April, September, December and January; Kotada-Madhawad 3,680 t (307 kg) September-March; Bombay (Sassoon Dock) 3,277 t (764 kg) September-December; Malpe 191 t (75 kg) September-November; Mangalore 221 t (80 kg) October-December and February; Cochin 1,762 t (144 kg) May-September; Vizhinjam 2,402 t (56 kg) mechanized, 458 t (45 kg) non-mechanized gear, fishery season being April-June and October. At Tuticorin and the neighbouring centres several types of gillnets were operated. The annual total fish landings in the different types and centres varied between 85 t and 1,331 t with catch rates varying between 32 kg and 149 kg. Seasons of good landings differed between centres. However, June-August and November-December and March recorded very good landings in this locality. The catch particulars at other centres along the east coast were; Mandapam (Pamban) 556 t (67 kg) December-April; Madras (Kasimedu) 326 t (440 kg) January-April and Visakhapatnam 111 t (7 kg) January-February.

Seerfishes formed 9-16% of the gillnet catch in Veraval, Cochin and Mandapam and 37% in Madras, 47-53% in Mangalore and 5-9% at Tuticorin and Visakhapatnam. Highest annual landings were recorded in the Veraval region (375 t - 748 t) at C/E of 16-63 kg with good fishery season during September-March, followed by Cochin 274 t (C/E 22 kg), July-November; Calicut 239 t (31 kg), September-November and January-February; Mangalore 116 t (43 kg), October-December; Malpe 90 t (35 kg), October-December; Madras (Kasimedu) 119 t (161 kg), January- March; Tuticorin 114 t (9 kg), June-August; Vizhinjam 92 t (2 kg), June-July and September (mechanized), 28 t (3 kg), July- October; Mandapam 89 t (11 kg), January-April and Visakhapatnam 9 t (0.6 kg), October-January. *Scomberomorus commerson* was the principal species that contributed to the seerfish catches followed by *S. guttatus, S. koreanus* and *S.lineolatus. Acanthocybium solandri* was recorded in stray numbers at some centres.

S. commerson of 7.5-136.0 cm total length were encountered in the catches, with the common size range being 50-90 cm. *S. guttatus* of 22.5-90 cm total length occurred in the fishery with the common size of 30-45 cm in Mangalore area, 32.5-40 cm at Tuticorin and 65-70 cm at Madras. Though juvenile fishes of *S. commerson* were dominant in the catches throughout the year at Tuticorin they were abundant during April-September. The total mortality rate and the exploitation rate for *S. commerson* were estimated as 1.26 and 0.5 in *Paruvalai* (115-170 mm mesh gillnet) and 4.65 and 0.87 in *Podivalai* (60-100mm mesh gillnet). In view of the higher rates of mortality as well as of exploitation obtained for *Podivalai* it is desirable to discourage operation of this gear in the Tuticorin area in order to improve the quality of seerfish fishery.

Tuna landings reveal a pattern in their species distribution although no such thing is discernible in other details of the fishery. Annual landings, percentage composition, catch rates and main fishery season at different centres were as follows : Veraval : 256-1,202 t, 7-33% (17-66 kg), September-March; Mangalore : 48 t, 22% (17 kg), October-November; Calicut : 241 t : (32 kg), August-October; Cochin : 914 t, 52% (75 kg), May-July; Vizhinjam 1,460 t (29 kg), April-July and October; Tuticorin 512 t, 38% (42 kg), June-August; Mandapam : 37 t, 7% (5 kg), January-March and Madras : 103 t, 32% (144 kg), January-April. Along the Veraval coast *Thunnus tonggol* contributed to the major share (37-83%) of the tuna catch followed by *T. albacares* (6-59%), *Euthynnus affinis* (4-12%) and *Auxis thazard* (1-12%) in the different landing centres. Further south and along the east coast, however, *E. affinis* was the dominant forming 50-55% of the tuna catch at Mangalore, Calicut and Cochin; 35% at Vizhinjam; 41% at Tuticorin and 99% at Mandapam and Madras, while *T. tonggol* formed only 21% of tuna catch at Mangalore, 5% at Calicut, 4% at Cochin and very negligible only along the rest of the coast. *A. thazard* and *A. rochei* were the other important species making significant contributions to the tuna catch from Calicut (34%) and further south namely Cochin (34%), Vizhinjam (53%) and Tuticorin (40%). Stray numbers of *Katsuwonus pelamis* were recorded at Veraval, Vizhinjam, Tuticorin and Madras and those of *Sarda orientalis* at Mangalore, Calicut, Cochin and Tuticorin. The size range of *T. tonggol* in the fishery was 28-106 cm with dominant sizes at 56-60 cm and 74-80 cm along the Veraval coast and at 36 cm and 68 cm at Mangalore. *E. affinis* occurred in the size range of 15-75 cm with the dominant size between 36 cm and 64 cm at Mangalore, around 48 cm at Cochin and at 42-50 cm at Vizhinjam. *T. albacares* was recorded at 70-130 cm length range with dominant sizes at 88-106 cm along the Veraval coast. *A. thazard* occurred in the length range of 22-48 cm with dominant size at 30-36 cm.

Mackerel (*Rastrelliger kanagurta*) catches by gillnet were notable only at Vizhinjam, Cochin and Mandapam with the annual landings of 502 t (C/E 9.4 kg) forming 18% of the gillnet landings and with main fishery season as March-July at Vizhinjam; 175 t (C/E 21 kg) forming 31% with the main fishery season during November-March at Mandapam; and 120 t annual catch at C/E of 10 kg with the main fishery season during May-July at Cochin. At Mangalore-Malpe centres the catches were poor at 9 t (C/E 2.5 kg) forming only 2.5% of the gillnet landings with September-October as the main fishery season. At Visakhapatnam 57 t (C/E 3.6 kg) was recorded, forming 51% of the gillnet landings with the main season as January-March. Fishes of 105-300 mm length occurred in

gillnet, dominant sizes being 185-280 mm. *R. faughni* was recorded during April-June and September at Visakhapatnam. Spawning activity was noticed throughout the year with it being intensive during May-June, August-September and February-March at Visakhapatnam.

Elasmobranchs dominated by sharks contributed to the gillnet landings all along the coast. North-west coast occupied a premier position in this regard. The catches amounted to 2,525 t (C/E 68 kg) forming 39% of the gillnet landings at Veraval while at Kotada-Madhawad the catch was 294 t (C/E 19 kg) forming 8% of the gillnet catch, each of these centres having distinctly different fishery seasons : April-September for Veraval and October-March for the other centre. At Bombay (Sassoon Dock) the catch was 667 t (C/E 156 kg) forming 21% of the gillnet landings with September-December as the fishery season. At other centres the catch particulars were as follows : Cochin 125 t (10 kg), 7%, May-June; Tuticorin (North) 116 t (71 kg), 70% in bottom-set gillnet, May-August; Mandapam 217 t (12 kg), February and May-December. At Mangalore, Calicut and Madras the annual landings of elasmobranchs ranged between 14 t and 42 t (C/E 2.4 kg - 51 kg) forming 7-22% of the gillnet catches. *Carcharhinus melanopterus* (65%) and *Scoliodon laticaudus* (19%) were the dominant species at Veraval. The latter occurred in the size range of 24-60 cm with dominant size at 42-44 cm. *Acetes* and prawns formed the major food items. At Bombay, sharks accounted for 91% followed by rays (6%) and skates (3%). In the Mangalore-Malpe area *C. limbatus* in 38-122 cm length range and *S. laticaudus* were the important sharks. The former occurred mainly during September-November, while the latter was available throughout the year. At Calicut *C. melanopterus* (72%) was the dominant species. At Cochin *C. melanopterus* (36%), *Rhizoprionodon acutus* (35%) and *Sphyrna lewini* (20%) were the dominant species. They occurred in the size ranges of 59-110 cm (65-85 cm), 41-93 cm (45-85 cm) and 48-102 cm (50-95 cm) respectively. At Tuticorin *Dasyatis bleekeri, D. uarnak, Aetobatus narinari* and *Mobula diabolus* were the dominant species in bottom-set gillnet. Sharks such as *Loxodon macrorhinus* and *C. sorrah;* and rays such as *Amphotistius kuhli* and *D. bleekeri* were the important elasmobranchs caught in other types of gillnets. *A. kuhli* of 260 mm disc length carried young ones measuring 62-100 mm in disc length in the uterus. For the first time the deep sea dog-fish shark, *Centrophorus moluccensis* (224 nos. weighing 820 kg) were recorded from the Gulf of Mannar during July. At Mandapam, sharks, mostly represented by *S. palasorra*, accounted for 87% of the elasmobranch landings. This species occurred in the size range of 10-109 cm with dominant size at 46-69 cm. At Madras *C. sorrah* and *C. limbatus* were the important sharks met with.

Carangid landings at Vizhinjam amounted to 334 t (C/E 8 kg) by motorized crafts and 56 t (C/E 5.5 kg) by non-motorized crafts and 109 t (C/E 9 kg) forming 6% of gillnet catch at Cochin, with quite contrasting fishery seasons namely May-September at Cochin and October-March at Vizhinjam. On the other hand, Mangalore had a very restricted carangid fishery season of September-October by gillnet with the annual landings amounting to only 8 t at C/E of 3 kg. *Alepes djedaba* (45%) was the dominant species of carangid followed by *Megalaspis cordyla* (11%) and *Decapterus russelli* (6%) and others at Cochin, while *M. cordyla* was the dominant species (58%) at Mangalore. At Vizhinjam *Selar crumenophthalmus* was the dominant species (44%) followed by *D. russelli*

(17%) and *Atule mate* (11%) and others. *A. djedaba* was abundant during May-July at Cochin while good landings of *S. crumenophthalmus* were obtained during November-December and February-March at Vizhinjam, whereas *M. cordyla* was significant in the carangid landings at Mangalore during October. *A. djedaba* of 191-321 mm length with dominant size at 201-271; mm, *M. cordyla* of 181-351 mm length with dominant size at 271-301 mm, and *D. russelli* of 151-221 mm length with dominant size at 181-201 mm were recorded at Cochin. *D. macarellus*, a deep water species was caught by motorized crafts operated off Vizhinjam during November-March.

Catfish landings by gillnet were noteworthy only along the north-west coast amounting to 192 t (13 kg) forming 5%, with the main fishery season during September-March at Kotada-Madhawad of Veraval area and at Bombay 215 t (51 kg) forming 6% the main season being same as at Veraval. The catches were poor to negligible at other centres along the rest of the coast except at Cochin and Tuticorin as detailed below : Mangalore 11 t (4 kg), 5%, September-October; Calicut 21 t (3 kg), August-October; Cochin 142 t (12 kg), 8%, June-September; Tuticorin and adjacent centres 51 t (1-4 kg), 3-4%, May-July, November-December; and Madras 0.3 t (0.4 kg), 0.1%, April. Further north along the east coast catfish catches by gillnet have become practically nil as at Visakhapatnam. Reviewing the catfish landings of this gear over the past 18 years (1972-'89) at Lawson's Bay, Visakhapatnam it is seen that the average annual yield of this gear dropped from 16.8 t (C/E 2.9 kg) of the period 1972-'81 to mere 1.7 t (C/E 0.19 kg) over the recent 8 year period (1982-'89). On the other hand, the average annual fishing effort during the same two periods had increased from 5,740 units to 9,001 pointing to the inescapable conclusion that the increase in the fishing effort has depleted the stock of catfish resources accessible for gillnetting off Visakhapatnam. It is likely that this unfavourable trend might spread to the adjacent trawling grounds. These catch trends of catfish could well serve as a warning signal to the future prospects of the other demersal fishery resources. At Mangalore *Tachysurus serratus* (67%), *T. thalassinus* (24%) and *T. tenuispinis* (9%) comprised the catfish catch, their length ranges together with the dominant sizes being 68-106 cm (68-82 cm and 88-106 cm), 48-92 cm (48-56 cm) and 44-54 cm (48 cm) respectively. At Malpe *T. dussumieri* was also met with in the catfish landings. At Cochin all the above four species were met with, their composition being 62%, 29%, 9% and trace respectively. At Tuticorin, on the other hand, *T. dussumieri* and *T. thalassinus* were the dominant species together accounting for 67% followed by *T. serratus*, *T. caelatus* and others. They occurred in the size ranges and dominant sizes of 44-92 cm (58-84 cm), 20-86 cm (22-36, 56-64 & 72-82 cm), 68-114 cm (92-104 cm), 16-40 cm (21-34 cm) respectively. At Madras *T. dussumieri* comprised the entire catfish catch.

Pomfrets had an annual yield of 301 t (C/E 20 kg) at Kotada-Madhawad (Veraval) forming 8% of the gillnet catch, with September-March as the main fishery season. At Sassoon Dock (Bombay) the main season was shorter being September-December with the annual yield of 446 t (C/E 104 kg) forming 14% of the catch and at Satpati (Bombay) catch was 879 t at C/E of 182 t with August-December as main season. Further south the catches were poor. At Mangalore and Malpe the annual catches were 4 t (1.4 kg) and 3 t (1.6 kg) respectively, better catches being obtained during September-November.

Pomfret landings at Cochin amounted to 32 t (2.6 kg) forming 1.8% of the gillnet catch, good catches being obtained during May and August-October. Bulk of the pomfret catch was obtained at 41-60 m depth off Mangalore and Cochin and at 21-40 m off Malpe. *Pampus argenteus* was the dominant pomfret species (65-70%) in the north-western sector bulk of the catches being in the range of 190-290 m, while *Parastromateus niger* was the dominant species (90-95%) further south occurring in the prominent length range of 170-250 mm in Mangalore-Malpe area and 340-380 mm in Cochin area.

Investigations on dolnet fisheries (PF/IP/2)

Investigations were carried out on the Bombay duck, *Coilia*, pomfret, catfish and crustacean resources with particular reference to the composition of young fish in the dolnet catches at Veraval and Bombay. The annual landing and catch rates (catch per unit/catch per haul) at Navabunder, Rajpara and Jaffrabad monitored from Veraval were 18,120 t (652 kg/130 kg), 34,283 t (1,045kg/139 kg) and 3,956 t (1,189 kg/152 kg) respectively. Fishing was carried out throughout the year except in June at Jaffrabad, with November-March, October-March and October-January as the main fishery seasons for the three centres respectively. Off New Ferry Wharf and Versova of the Bombay area, the annual catches and catch rates were 227 t (111 kg/52 kg) and 11,889 t (91 kg per haul) respectively. There was no fishing due to monsoon off Versova during July-August and fishing activity was low during June and September. Catch rates were higher during May-June and September-November off Versova and during June-December off New Ferry Wharf.

Bombay duck in Veraval area accounted for 50-77% of the dolnet landings, with the catch rates of 329-916 kg/unit and 66-117 kg/haul. October-December was the main fishery season. At Versova, Bombay duck formed only 9% of the dolnet landings with the catch rate of 8 kg/haul. Seasonal trend here was erratic. In the Veraval area, fish of the length range 30-33 mm was caught with 4-6 modal sizes, the dominant size being 30-105 mm. Young fish catch of 66-177 t was landed at the three centres, January-March being the period of their abundance followed by August- September and April. Seasonal occurrence of gravid fish differed between areas, the overall picture being their availability almost throughout the year in the Saurashtra area. Off Versova, fish of 30-360 mm with dominant size at 135-225 mm was caught. Young fish was abundant in September and gravid fish in April.

Coilia dussumieri in Veraval area accounted for 11-20% of the dolnet landings with catch rates of 127-170 kg per unit and 16-26 kg/haul. January-March was the main fishery season. At Versova it formed only 3% of the dolnet catch at 3 kg/haul, good catches being recorded during January-February and September. In Veraval area fish of 66-201 mm was caught, 146-166 mm length being dominant. Young fish catch of 78-162 t was landed at the three observation centres of Veraval area, December-March being the period of their abundance. Gravid fish were met with during August, October, December-January and March. Off Versova, fish of 30-220 mm length was caught, those in 110-160 mm length being dominant. Young fish were met with during January-April.

The pomfret, *Pampus argenteus* in Veraval area formed only 0.3- 0.6% of the dolnet landings with catch rates of 3-6 kg/unit and 0.4-0.8 kg/haul. October-December was the main fishery season. Fish of

30-260 mm length occurred in the fishery with 70-100 mm size fish being dominant followed by fish in three other sizes : 120-140 mm, 180-200 mm and 210-240 mm. Young fish catch of 9-15 t was landed at the three observation centres each accounting for 5-15% of the pomfret catch by dolnet. Fish in gravid state were seldom met with.

Catfish in Veraval area amounted to 149-279 t at the three observation centres with catch rates of 5-9 kg/unit and about 1 kg/haul, also forming about 1% of the dolnet landings. November-February marked the main fishery season. At Versova (Bombay) 144 t of catfish was landed at 8 kg/unit forming about 1% of the dolnet landings. January, April-May, October and December witnessed good catches. *Tachysurus dussumieri* (44%) was the dominant species followed by *T. caelatus* (38%), *Osteogeneiosus militaris* (16%) and others. *T. caelatus* of 90-460 mm length with dominant size at 350-390 mm occurred in the fishery. Males (77%) dominated the catch and gravid females were rare.

An estimated 2,741 t of non-penaeid prawns forming 15% of the dolnet catch, at 129 kg/unit and 20 kg/haul was landed at Veraval. This is 25% less than that of the previous year. Highest catch of 610 t was obtained in November and lowest (98 kg) in March. Non-penaeid catch was mainly constituted by *Acetes* spp. (82%), *Nematopalaemon tenuipes* (12%), *Exhipploysmata ensirostris* (5%) and others. Early maturing females dominated the catches of the latter two species although a high incidence of berried females was met with for *N. tenuipes* in August.

Off New Ferry Wharf (Bombay) the crustacean catch amounted to 149 t forming 66% of the dolnet landings with catch rates of 73 kg/unit and 34 kg/haul. Good catches were obtained during June-December. Non-penaeid prawns accounted for the bulk (62%) of the crustacean catch followed by penaeid prawns (37%), crabs and *Squilla*. *Acetes indicus* and *A. sibogae* formed the dominant constituent (83%) of the non-penaeid catch followed by *N. tenuipes* (13%) and *E. ensirostris* (4%). Good catches of the first three species were obtained during April-August, November-February and April-October respectively. Species composition and their seasons of abundance of the penaeid catches were : *Parapenaeopsis stylifera* (40%) June-July, *P. sculptilis* (11%) July-October, *P. hardwickii* (1%), *Metapenaeus brevicornis* (22%) July, *M. affinis* (11%) September-October and *Solenocera crassicornis* (15%) June-July and January- February. Juveniles accounted for 56%, 60%, 93% and 88% of the catches of the first, fourth, fifth and sixth of the aforementioned species.

At Sassoon Dock the non-penaeids formed a good proportion of the dolnet landings. *Acetes* was represented mainly by *A. indicus* and *A. johni*. A new hyppolytid shrimp was encountered in the area. Berried females were abundant for *N. tenuipes* and *E. ensirostris* in July and August.

Investigations on the purse seine fishery and its impact on the resources (PF/IP/3)

Investigations on the purse seine fishery during the period were continued at Karwar, Mangalore (Bunder), Malpe and Cochin.

During the year an estimated 42,410 t was landed by a total of 24,249 units. Maximum landings were observed at Malpe (18,980 t) followed by Mangalore (Bunder) (16,855 t), Karwar (3,521 t) and Cochin (3,052 t). Highest catch rate also was observed at Malpe (2.601 t) followed by

Table 1. Purse seine catch trends at different centres in comparison with those of the previous year (in units and tonnes)

Centre	Effort	Catch	C/E	Effort	Catch	C/E	Effort	Catch	C/E
		1990 - '91			1989 - '90			Difference	
Karwar	2858	3522	1.23	3952	6248	1.58	(-) 1094	(-) 2727	(-) 0.35
Malpe	7297	18980	2.60	12919	42409	3.28	(-) 5622	(-) 23429	(-) 0.68
Manga-lore	12795	16856	1.32	14217	24173	1.70	(-) 1422	(-) 7317	(-) 0.38
Cochin	1299	3052	2.35	1555	4956	3.19	(-) 256	(-) 1904	(-) 0.84

Cochin (2.349 t), Mangalore (Bunder) (1.317 t) and Karwar (1.232 t). However, compared to the previous year, the purse seine fishery suffered a set back this year. There was an overall decrease in the effort, catch and catch rate at all the observation centres (Table 1). Decrease in the catch was to the extent of 2,727 t at Karwar, 23,429 t at Malpe, 7,317 t at Mangalore and 1,904 t at Cochin. The catch rates decreased by 21- 23% at these centres. Though fishing was suspended during the monsoon period (June-August) at the three southern centres this period was of a shorter duration (June-July) at Karwar. Post-monsoon period of September-November marked the main fishery season at Karwar, Malpe and Mangalore accounting for 77%, 88% and 82% of the annual catches at the centres respectively. A defnitie fishery season, however, was not discernible at Cochin. The major resources which contributed to the fishery included sardines (32.79%), mackerel (32.32%), carangids (17.52%), whitebaits (8.30%), tunas (0.75%), catfishes (0.53%) and pomfrets (0.07%). Catch particulars of oil sardine and mackerel in comparison with those of last year are given in Table 2.

Fishing was carried out at two depths (11-20 m and 21-40 m at Mangalore, Bunder & Malpe). At Cochin, operations were mainly carried out in the 21-40 m depth range. However during January to March period, operations were made at a slightly lower depth range of 18-24 m. In Karwar, the units were operated only at 21-

Table 2. Catch particulars of oil sardine and mackerel in comparison with those of the previous year (in units and tonnes)

	Oil Sardine				Mackerel			
	Karwar	Malpe	Mangalore	Cochin	Karwar	Malpe	Mangalore	Cochin
1990 - '91								
C	811	6042	3000	2205	1927	7574	3468	736
C/E	0.28	0.83	0.23	1.70	0.67	1.04	0.27	0.57
1989 - '90								
C	857	5957	5790	2692	4895	27361	12217	1792
C/E	0.22	0.46	4.07	1.73	1.24	2.12	0.86	1.15
Difference								
C	(-) 46	(+) 85	(-) 2790	(-) 487	(-) 2968	(-) 19787	(-) 8749	(-) 1056
C/E	(+) 0.06	(+) 0.37	(-) 3.84	(-) 0.03	(-) 0.57	(-) 1.08	(-) 0.59	(-) 0.58

40 m depth range. At Mangalore (Bunder) and Malpe, fishing was more intensive in the 11-20 m depth range while at Cochin, fishing was more intensive in the 21-40 m depth range.

Species composition and biology of important resources were studied. Among sardines, *Sardinella longiceps* dominated at all centres and comprised 81 to 98% of the total sardine catch. *S. gibbosa* was observed at all the centres and contributed 15.30%, 9.00%, 6.93% and 0.07% at Karwar, Mangalore (Bunder), Malpe and Cochin respectively. *S. fimbriata* was also observed at all centres and it contributed 3.15% of the sardine catch at Malpe, 1.86% at Mangalore (Bunder), 1.31% at Cochin and 1.24% at Karwar. *S.brachysoma* observed only at Mangalore comprised 16.48% and 1.76% respectively at Malpe and Bunder. *S. dayi* and *S. albella* occurred only at Karwar and contributed to 0.46% and 1.49% of the sardine catch at the centre. Among tunas, *Euthynnus affinis* was the dominant species and contributed 86.09% at Mangalore (Bunder), 93.6% at Malpe and 100% at Cochin. *Auxis thazard* comprised 13.91% at Mangalore (Bunder) and 3.2% at Malpe. *Thunnus albacares* observed only at Malpe contributed to 3.2% of the tuna catch. At Karwar the entire tuna catch consisted only of *A. rochei*. Catfishes comprised of two species at Karwar and Mangalore. *Tachysurus serratus* dominated at Karwar (55.70%) and Mangalore (Bunder) (98.93%) whereas *T. tenuispinis* dominated at Malpe (95.34%). At Cochin the carangid catch was dominated by *Decapterus russelli* (93.55%) and the rest by *Alepes djedaba*. *D. russelli* comprised 48.20% and 22.90% at Malpe and Mangalore (Bunder) respectively. *Chorinemus* sp. observed at Mangalore contributed 2.4% and 0.4% respectively at Bunder and Malpe and *Caranx kalla* comprised 12.20 and 36.00% of the carangid catch at the above centres. Whitebaits were observed only at Mangalore. *Stolephorus devisi* dominated both at Bunder (99.91%) and Malpe (98.39%). The other species included *S. bataviensis* forming 0.07% at Bunder and 1.61% at Malpe and *S. macrops* 0.02% at Bunder. The pomfret catch observed at Cochin consisted only of *Parastromateus niger*.

The total length of *S. longiceps* had a range of 6.0-21.2cm (modes: 8, 9, 11, 12, 13, 15, 20) at Karwar, 6.5-21.0 cm (modes: 8.5,11,13,15,17.5,18) at Mangalore and 10.5-19.0 cm (mode: 16) at Cochin. The total length of *S. gibbosa* ranged from 6.5 to 17.5 cm (modes: 8,9,12,14) at Karwar and 11.5-18.0 cm (modes: 13,14,15) at Mangalore. The total length range (modes) of *S. albella*, *S. fimbriata* and *S. dayi* at Karwar centre was 13.0-15.5 cm (14), 8.0-9.5 cm (8.5) and 9.5-15.5 cm (11,15) respectively.

The total length of *R. kanagurta* ranged from 15.5 to 28.9 cm (modes : 15.5, 17, 18, 21.5, 24.5, 25.5, 28.5) at Karwar, from 9.0 to 26.0 cm (modes: 15.5, 17, 18.5, 19.5, 21, 23, 24.5) at Mangalore and from 17.0 to 22.0 cm (mode: 17.5) at Cochin. Among tunas, *A. rochei* had a total length of 15.5 to 19.5 cm with a single mode at 17.0 cm. The total length of *E. affinis* ranged from 30 to 44 cm with a single mode at 40 cm. The carangids *C. kalla* and *D. russelli* had a wide size range with multiple modes. The total length of *C. kalla* ranged from 5 to 15.5 cm with modes at 8,10, 12.5 and 13 cm and that of *D. russelli* ranged from 11.5 to 19.0 cm with modes at 14,15 and 18.5 cm. The total length of the whitebait, *S. devisi* ranged from 5 to 10 cm with a single mode at 8.5 cm. The catfish, *T. serratus* had a total length range of 12.0 to 28.0 cm with a single mode at 15.0 cm.

Adult fish formed nearly half the catch in the case of the oil sardine at

Karwar, Mangalore and Malpe and 43% at Cochin. Studies on the sex ratio and maturity of predominant species indicated that for *S. longiceps*, males dominated over the females at Cochin and Karwar. At Mangalore, sexes were equally distributed. Fishes with gravid gonads contributed to 47.37% at Cochin whereas at Karwar and Mangalore they formed only 2.90 and 8.34% of the adult population. Among lesser sardines at Karwar adults formed 75% and 63% in respect of *S. dayi* and *S. albella* respectivley, whereas for *S. gibbosa* the adults accounted for 42%. Females predominated and *S. gibbosa* and *S. albella* in spent condition comprised the entire adult catch at Karwar. In the case of *R. kanagurta*, the adult fishes formed 53% and 55% at Karwar and Cochin respectively. At Mangalore and Malpe adults accounted for only 42%. Females dominated at Karwar and Cochin. Fishes with gravid and spent gonads contributed to the fishery at Karwar and Mangalore, whereas at Cochin the entire adult catch consisted only of spent fishes. Among carangids, females dominated for *C. kalla* and males for *D. russelli*. Spent fishes were not observed in the catch.

Study on economics of purse seine operation at Cochin Fisheries Harbour indicated that the gross revenue per day of operation during the year amounted to Rs. 8,500/-. The total operating cost per day was worked out at Rs. 4,387/- of which the major share of Rs. 2,195/- was contributed by wages followed by fuel cost of Rs. 1,320/-. The total cost including fixed cost was worked out at Rs. 6,891/- leaving a net profit of Rs. 1,609/- per day of operation. With 120 fishing days during the year, the annual net profit of purse seine unit came about Rs. 193,080/-.

The past (1984-'88) data on the resources of the oil sardine fishery on the west coast of India has been analysed and population parameters were obtained. The asymptotic length ($L\infty$), growth coefficient (k) and the total instantaneous rate of mortality (z) of the species were in the order of 221 mm, 0.75 (annual) and 2.24 respectively. Employing Pauly's method, the component of M (natural mortality) and F (fishing mortality) were 1.36 and 0.88 respectively. The present level of exploitation rate and the estimates of average annual biomass and the maximum sustainable yield of the resources are being evaluated to suggest appropriate management measures.

Investigations on tuna fisheries and related aspects in Lakshadweep (PF/IP/4)

Tuna fisheries investigations in Lakshadweep could be carried out only at Minicoy this year. The contribution of pole and line (97.5%) to the tuna landings in the island was much higher than that of troll lines, amounting to 782 t at C/E of 310 kg against 1,124 t at C/E of 287 kg obtained last year. Fishing effort decreased to 2,522 units from 3,915 units of last year. Shortage of baitfishes and diesel were partly responsible for the reduction in effort. Fishing was intense during October-January and March-April. Good catches were obtained during October-November at C/E of 704 kg and 473 kg respectively. Tuna accounted for 99% of the catch. Troll-lines landed only 20 t of tuna at C/E at 26 kg against 14 t at C/E of 20 kg obtained last year. Here, tuna accounted for 90% of the catch. Skipjack tuna was the dominant species (94%) in pole and line and the yellow fin tuna (67%) followed by the skipjack tuna (32%) in the troll-lines.

Length of *Katsuwonus pelamis* landed by pole and line ranged from 28-71 cm. For the whole year the major mode

was at 61 cm with minor ones at 39 cm and 51 cm.

In April the major mode was at 53 cm which could be traced to 63 cm in January through different months. The secondary mode at 31 cm in the same month was found at 55 cm in February. The growth was traced based on the progression of modes which gave a growth line with K = 1.36 and $L\infty$ = 63.76 cm.

The catch of livebaits also decreased to 3,630 kg this year from 5,900 kg of last year. There was a decline in the catch of all species of baitfishes except *Spratelloides gracilis* which contributed 30.66% of the total baitfish catch. Sprats contributed 54.79% followed by caesionids (37.05%) and apogonids (5.45%). However, there has been an increase in the CPUB to 215.6 kg from 190 kg of last year. CPUB was maximum in October when maximum tuna CPUE was observed. But maximum baitfish catch was recorded in January and March.

Another interesting feature this year was the extensive use of artificial baits made of synthetic materials in the pole and line fishery. The efficiency of artificial bait is not comparable to that of baitfishes. They are used when livebaits are in short supply. Local types as well as imported types from Japan were used. The local variety has a barbed hook with larger artificial bait and the Japanese one has a barbless hook with a smaller artificial bait.

Tagging of commercial species of fish and shellfish (PF/IP/5)

At Mandapam a total of 136 sacred chanks, *Xancus pyrum* were tagged and released in Palk Bay and Gulf of Mannar. The ranges of length, breadth and weight of the chanks released were : length 83.28 to 127.58 mm, breadth 44.58 to 66.12 mm and weight 90 to 250 g. The tagged chanks were released at a depth of 5.0-5.5 m. From the data recorded on the five recaptured chanks, it could be inferred that the chanks could attain a maximum shell diameter-wise growth of 0.0170 to 0.0276 mm per day. The chanks were found to migrate up to 5-6 Km from the site of release at an estimated rate of 26.04 m per day.

At Tuticorin a total of 620 sacred chanks were tagged and released. While 74.5% of them were released in open sea, the others were released in the harbour. The average size and weight of the chanks released were : length 84.69-145.16 mm., diameter 42.8-77.4 mm and weight 61.0-444.6 g. The growth and growth rates were estimated from the recovered chanks.

At Cochin, prawns (134 nos.) were tagged during the first half of the year. The size range of the prawns tagged were as follows : *Penaeus indicus* (94-157 mm), *P. monodon* (143-174 mm)*Parapenaeopsis stylifera* (62-129 mm), *Metapenaeus monoceros* (84-112 mm) and *M. dobsoni* (82-105 mm).

Atlases on marine finfishes and shell fishes (PF/IP/6)

Data for the preparation of atlases were collected and the draft drawings were made. However, they could not be made press ready for want of facilities. It is recommended for the termination of the project as the completion period is scheduled to be 1990-'91.

DEMERSAL FISHERIES DIVISION

Investigations on the resources exploited by small mechanised trawlers, 14 m & below (DF/IP/1)

The total trawl landings in India during the year 1990 was estimated at 8,71,000 t as against 7,63,000 t of 1989 thus registering an increase of about 1,08,000 t. The west coast contributed 6,32,000 t and the east coast 2,39,000 t in 1990 against 5,66,000 t and 1,97,000 t respectively in 1989. Thus, the overall increase at all India level is reflected in increased landings along both the coasts.

Prawns accounted for about 1,67,000 t (19%) of the total trawl landings of which penaeids contributed 1,32,000 t. Maximum prawn landings were recorded from the west coast. Perches contributed 12% of the total catch, 75% of which was threadfin breams (82,000 t). The other important resources were stomatopods (67,000 t), croakers (70,000 t), cephalopods (49,000 t), carangids, ribbonfishes (45,000 t each), silverbellies (44,000 t), lizardfishes (25,000 t), elasmobranchs (21,000 t), goatfishes (19,600 t), crabs (19,500 t), catfishes (11,000 t), oil sardine (8,200 t), mackerel (7,000 t) and pomfrets (5,200 t).

Observations on the catches brought by small trawlers at all the important centres were continued during the year (April 1990-March 1991). The catch composition, species distribution of important groups, peak fishing season and biology of dominant species were studied.

Veraval : An estimated 69,000 trawler units landed 90,000 t during the year, compared to 56,000 units and 70,000 t the previous year thus registering a 25% increase in both effort and catch. Crustaceans contributed 53% of the catch, the bulk (75%) of which was penaeid prawns. Other major groups recorded were the ribbonfishes (12,000 t), crabs (5,500 t) nemipterids (2,100 t), stomatopods (1,800 t), elasmobranchs (1,500 t), lizardfishes (940 t), lobsters (250 t) and pomfrets (200 t).

Among penaeid prawns, *Solenocera crassicornis* (42%) followed by *Parapenaeopsis stylifera* (18.6%) dominated the catch. *Penaeus penicillatus, P. semisulcatus, Metapenaeus kutchensis* and *M. monoceros* were the other species recorded. Lobsters were represented by *Panulirus polyphagus* and *Thenus orientalis*. Of the important finfish groups studied, *Trichiurus lepturus* having a length range of 8-112 cm dominated the ribbonfish catch; *Scoliodon laticaudus* (6.4-28.1 cm) among elasmobranchs; *Nemipterus japonicus* (8-31 cm) among threadfin breams and *Saurida tumbil* (11 - 49.9 cm) among lizard fishes. *Acetes*, other species of prawns and squids were the most dominant food items except in *S. tumbil* where fishes followed by squids were the major food items.

Bombay : The total trawl landings at New Ferry Wharf and Sassoon Dock were estimated at 43,700 t and 50,000 t respectively as compared to 73, 100 t and 89,000 t the previous year. New Ferry Wharf recorded a decline of 38% in catch and 12% in CPUE. Changes in monsoon pattern and shortage of fuel due to Gulf crisis have been attributed for the decline in the effort. Landings of

elasmobranchs, squids, perches, Bombayduck, lizard fishes and catfishes showed declining trend. At Sassoon Dock the catch and CPUE increased by 28% and 15% respectively and the effort declined by 10%. Significant increase in the landings of penaeid prawns and cephalopods and marginal increase of perches was noticed here.

Various growth parameters of *Johnius dussumieri* in the Von Bertalanffy Growth Formula (VBGF) were estimated. The values obtained were, $L\infty$ = 270 mm, K = 0.91323 (annual) and t_o = - 0.019991. The species attained 163 and 227 mm at the end of I and II years of growth. Total mortality for the species was estimated as 2.15 (natural mortality 'M' = 1.91 and fishing mortality 'F' = 0.24), E = 0.1162 and U = 0.1027. Population studies made at the centre reveal that *Johnieops macrorhynus* and *J. vogleri* are optimally exploited but the exploitation rate of *J. sina* is beyond the optimum level. The 'E' for *Otolithes cuvieri* on the other hand is well below the optimum level. Similar studies were carried out on *Priacanthus hamrur* and the values obtained for the VBGF were $L\infty$ = 360 mm, K = 0.76 (annual) and t_o = - 0.009116 . The species attained a total length of 193, 276 and 354 mm in I, II and III years of growth. The total, natural and fishing mortalities were estimated as 1.97, 1.52 and 0.45 respectively. The growth of *Epinephelus diacanthus* was estimated using the ELEFAN programme.The values obtained for the various parameters were $L\infty$ = 455 mm, K = 0.45 (annual), Z = 1.07, M = 0.76 and F = 0.31.

Karwar : About 15,000 trawl units landed 590 t of prawns and 3,000 t of fishes at the centre. Prawns were dominated by *P. stylifera* followed by *M. dobsoni*. The catfish landings continued to be poor (less than 1 t) this year. At Tadri, 650 t of prawns was landed by 15,000 trawlers. *M. dobsoni* has dominated followed by *P. stylifera*.

Mangalore: The total landings at Mangalore and Malpe were estimated at 27,000 t by an estimated 57,000 units. Mangalore has contributed to 49% of the catch landed and 59% of the effort expended. The total landings registered an increase of 21% over that of the previous year. Stomatopods comprising 25% of the catch dominated the landings followed by penaeid prawns (8%), cephalopods, carangids and threadfin breams (7% each), flat fishes (6%), lizard fishes, sciaenids and *Platycephalus* spp. (3% each). Improvement in prawn landings by 27%, threadfin breams by 47%, lizard fishes by 16%, carangids by 26%, anchovies by 24% and cephalopods by 50% was noticed this year. However, the landings of catfishes and mackerel have decreased. Among threadfin breams, *N. japonicus* has dominated (82.4%). The total length of the fish ranged from 40-250 mm. Mature fishes were abundant during November to January which is the main spawning season for the fish. Peak landing of lizard fishes was during March and the catch was dominated by *S. tumbil* (73%). The total length ranged from 100- 420 mm. Length at first maturity was estimated at 270 mm for males and 250 mm for females.

Calicut: Total trawl landings was estimated at 2,800 t for an effort of 16,000 (CPUE = 175 kg). An increase of 29% was recorded in the total landings when compared to the previous year. Remarkable increase in the landings of soles and pomfrets was noticed during the year. The soles were represented only by *Cynoglossus macrostomus* having a total length ranging from 75 - 155 mm. Indeterminate and immature fishes formed the mainstay of the fishery during most of the months.

Cochin : A marginal increase in landings and effort was observed this year when compared to the previous, the landings and effort expended being 28,000 t and

26,000 t and 80,500 and 68,400 units respectively. Among finfishes, threadfin breams (33%) dominated followed by carangids (15%), flatfishes (3%), barracudas (3%), lizard fishes (2%); crustaceans comprised mainly of penaeid prawns (14%) followed by crabs (2%); cephalopods contributed to 9% of the total catch.

Penaeid prawns were mainly represented by *M. dobsoni* (43.4%) and *P. stylifera* (43.2%). *M. dobsoni* was caught during April, May and December - March, with total length ranging from 41-120 mm for females and from 46-95 mm for males, the former outnumbering the latter. Spawners were abundant during November and December. The total length of *P. stylifera* ranged from 36- 120 mm in females and 41-160 mm in males. Juveniles entered the fishery in large numbers during the 3rd week of June.

The penaeid prawn landings at Sakthikulangara showed a marked increase this year compared to previous year. The respective catch and CPUE being 8,800 t and 5,200 t, and 62 kg and 43 kg. This 68% increase was mainly due to increase in the landings of 'Karikkadi' and *Trachypenaeus* spp. At Munambam, paneaid prawn landings estimated at 1,350 t, recorded a 54% decline in catch compared to the previous year. *M. dobsoni* (54%) followed by *P. stylifera* (36%) have contributed to the landings.

Ban on trawling operations along the Kerala coast was imposed this year for one month from 28th June to 27th July 1990.

The economic performance of small trawlers at Cochin Fisheries Harbour has showed a better trend as compared to earlier years. On an average, a trawl unit has earned a gross income of Rs. 3,000/- per day of operation. The operating coast was worked out at Rs. 1,900/- comprising Rs. 990/- as fuel cost and Rs. 630/- as wages. After deducting the costs from the annual revenue, the net profit per unit was worked out at Rs. 92,700/-.

Tuticorin: About 12,000 t was landed by an estimated 27,000 units. Perches formed 24% of the total catch followed by silver bellies (14%). *Stolephorus* spp. (420 t), sciaenids (300 t), prawns (230 t), seerfishes (180 t) and catfishes (90 t) were the other important resources. The prawn catch has declined by about 60 t this year.

Lethrinus nebulosus followed by *Scolopsis bimaculatus* were dominant among perches and *Leiognathus dussumieri* followed by *Gazza minuta* dominant among silver bellies. *N. delagoae* comprised the threadfin bream catch. Among prawns, *P. semisulcatus* was dominant (83.5%), with females outnumbering the males throughout the year. Studies at the centre have revealed that the seerfish fishery especially that of *Scomberomorus commerson* is exposed to high fishing pressure by trawlers. Trawling ban was imposed by the Government during November 1990.

Mandapam: The total trawl landings at Rameswaram, Mandapam and Pamban were 11,800 t, 4,700 t and 4,200 t with efforts of 51,500, 44,500 and 9,100 units respectively. Silverbellies dominated the landings in all the centres. The other important resources at Rameswaram include, elasmobranchs (5.6%), sciaenids (2.5%), cephalopods (2.1%), carangids (2.0%), flatfishes (1.4%) and catfishes (1.0%). At Mandapam penaeid prawns contributed 15.0%, elasmobranchs 9.4%, crabs 4.5%, cephalopods 3.5%, flatfishes 2.8% and sciaenids 1.5%. Penaeid prawns contributed 4.8% and sciaenids 1.7% at Pamban.

Tachysurus thalassinus has formed the dominant catfish species in the Palk Bay

(28.5%) and Gulf of Mannar (54.2%). However unusually large number of *T. tenuispinis* were caught off south east coast at a depth of 30 m. Among flatfishes, *Cynoglossus macrolepidotus* has dominated comprising 67.30% and 50.18% respectively at Palk Bay and Gulf of Mannar.

Madras: About 21,000 t were landed by 29,000 units with a CPUE of 720 kg. A decline of 1,600 t and 9,800 units was recorded this year compared to the previous year, which has been attributed to shortage of fuel due to Gulf war. Silverbellies (17%) followed by threadfin breams (15%), ribbonfishes (9%) crustaceans (8%), molluscs (7%), lizard fishes (5%) and sciaenids (4%) have contributed to the catch.

Silverbellies were represented mainly by two species, *L. bindus* and *Secutor insidiator* whereas threadfin breams were represented by *N. mesoprion* (56%), *N. japonicus* (24%), *N. delagoae* (14%) and *N. tolu* (5%). Sciaenid fishery was good during December-March and was composed of *O. ruber* (24.5%) and *Johnius carutta* (23.2%). Several prawns and lobster species have contributed to the crustacean fishery. Among prawns, *M. dobsoni* (17.6%), *P. indicus* (13.3%), *P. maxillipedo* (10.6%), *M. monoceros* (6.6%), *M. stridulans* (8.2%) and *P. semisulcatus* (8.2%) have supported the fishery throughout the year. *P. stylifera* and *P. longipes* were landed during July-August and *S. crassicornis* during July. Lobster fishery was carried out during July to January with the peak in August. *Panulirus homarus* followed by *P. versicolor* and *P. ornatus* have contributed to the fishery. Among cephalopods, cuttlefishes contributed 57% and squids 43%. *Sepia pharaonis* was dominant among cuttlefishes and *Loligo duvauceli* among squids.

Kakinada: An estimated 33,000 units have landed 13,000 t at the centre. Prawns have dominated (4,100 t), followed by sciaenids (1,200 t), ribbonfishes (1,000 t), silverbellies (490 t), carangids (400 t), *Stolpehorus* spp. (340 t), threadfin breams (230 t) and cephalopods (120 t). Non-penaeid prawns have contributed 865 t. When compared to the last year, the effort was reduced by 21% but the catch has increased marginally (1%).

Stock assessment studies on *P. monodon*, *M. monoceros*, *P. indicus* and *M. dobsoni* indicate that there is need to reduce the present effort by 20% to achieve MSY. As trawling is mainly conducted for prawns and MSY is obtained at reduced effort levels in some species, reduction in effort by 20% will not alter the current yields.

The estimated MSY for the fishes such as *N. japonicus*, *L. bindus*, *S. insidiator*, *Nibea maculata* and *Atrobucca nibe* is obtained at an effort greater than that at present. However, increase in yield at effort greater than the present can only be marginal and any further increase in effort will not result in proportional increased returns. The length-weight relationship of *N. maculata* gave the value log W = -5.033911 + 3.076203 log L.

Visakhapatnam: The landing at the centre (5,000 t) decreased by 4% this year compared to the previous year. Decline was mainly due to a fall in threadfin bream landings. Landings of catfishes, whitebaits and other perches also have declined. However, landings of prawns, cephalopods, goatfishes, sciaenids, lizardfishes, silverbellies and ribbonfishes increased.

The cephalopods consisted of cuttlefishes (53.2%) and squids (43.8%). *S. aculeata* formed 39.8% of the cuttlefish catch followed by *S. pharaonis* (34.9%) and *Sepiella inermis* (10.3%). Lizard fishes were represented by *S. undosquamis* (84.2%) and *S. tumbil* (15.7%). The fishery was mainly

sustained by the 1 + year old fishes. *T. thalassinus*, (84%) followed by *T. tenuispinis* (10%) and *T. dussumieri* (6%) contributed to the catfish fishery. Silverbellies were represented by *L. bindus* (38%), *S. insidiator* (25%) and *G. minuta* (16%).

Paradeep: About 1,900 t of penaeid prawns were landed by an estimated 35, 400 units this year as compared to 2,500 t by 36, 900 units the previous year. *P. sylifera* (28%) dominated, followed by *M. lysianassa* (14%), *M. dobsoni*, *P. hardwickii* (9% each) *S. crassicornis*, *M. monoceros* (8% each) and *P. monodon* (3%).

Results of the exploratory survey of the Indian EEZ by FORV *Sagar Sampada* (DF/IP/4)

The distribution, abundance, species composition and biology of conventional and non-conventional finfishes, crustaceans and molluscs caught in the pelagic and bottom trawls operated by FORV *Sagar Sampada* during Cruise Nos. 71-80 were studied. The bottom trawls in general brought in more catch compared to the pelagic trawls. Finfishes were landed during most of the cruises with nemipterids forming the most dominant group. *Nemipterus metopias* was the dominant species along the south-east coast (Cruise No. 72). The fish had a length range of 11-17 cm with mode at 14 cm. Along the south-west coast, *N. mesoprion* (Cruises 74, 75 and 79) and *N. japonicus* (Cruise No. 77) contributed to the fishery. Record catch rates of 6.0-13.3 t per hour was obtained for *N. mesoprion* off Kerala at a depth range of 50-60 m. The total length of this species ranged from 10 to 20 cm with modes at 15 and 19 cm. *N. japonicus* had a length range of 12-23 cm with modes at 15 and 21 cm. Other resources included lizard fishes, carangids, mackerel and elasmobranchs in Cruise No. 71 and carangids in Cruise No. 77, both operated off the southwest coast. Cruise No. 73 operated off Andamans has landed perches (*Lethrinus*, Lutianids) and carangids (*Decapterus* sp.).

Non-conventional resources were observed only during Cruise Nos. 72, 74, 75, 77 and 79. *Priacanthus hamrur* formed a component in all the above cruises and were caught from a depth ranging from 40 to 100 m. The total length of this species ranged from 7 to 30 cm with multiple modes. *Psenes indicus* was caught from a depth range of 48-98 m (Cruise No. 72). The fish had a total length of 11-20 cm with mode at 16 cm. *Trichiurus lepturus* having a total length of 66-71 cm (modes 60 and 64 cm) and *Epinephelus diacanthus* having a length range of 16-21 cm (19 cm) was caught from a depth of 40-80 m off the south-west coast.

Crustacean resources consisted mainly of prawns and crabs. Special cruises (Nos. 74 - 77) were made to study the inshore-offshore migration of *Karikkadi* in the shelf waters off Kerala coast during the monsoon season. Study of the different environmental and biological factors responsible for the movement of *Karikkadi* was also taken up. The study has confirmed the earlier finding on offshore migration of *Parapenaeopsis stylifera* and the species was available in areas as deep as 80 m. Maximum concentration of 200 kg/hour was observed at 47 m off Cochin.

Loligo duvauceli (10 kg) and *Sepia pharaonis* (5 kg) were caught from a depth of 30-120 m along the south-west coast (Cruise No. 77). The former had a length range of 8-19 cm, all in mature condition; while the latter had a length range of 10-18 cm, all in immature condition.

Studies on artificial reefs (DF/IP/5)

Good landings of cuttlefish obtained during the previous year from the reefs installed off Valiathura at Vizhinjam have prompted artisanal fishermen there to

establish more reefs with financial support from some local fish merchants. However, in order to minimise exploitation by middlemen, the voluntary agencies, "The South Indian Federation of Fishermen Societies" and "The Programme for Community Organisation" have financed the construction. The locations of the reefs are : four off Valiathura and one each off Puthenthura, Adimalathura and Thumba. Of these reefs, six are of triangular concrete modules and the one off Adimalathura is of "hut" type bamboo structure.

Fish catches from the reefs installed during the previous year were monitored. The reef off Valiathura made of tubular concrete modules produced 6.3 t of fishes and the one off Kochuthoppu made of "well" type concrete modules yielded 31.4 t. Fishing season at the reefs were from November to May with an average catch rate of 15.7 kg in the former and 13.8 kg in the latter. The cuttlefish *Sepia* and finfishes *Lutjanus, Nemipterus* and *Priacanthus* were the common ones caught by hooks and lines. *Euthynnus, Decapterus* and mackerel were also found to inhabit the reefs. It has been estimated that as a result of installation of the ARs, the contribution of fish catches from the reefs has increased from 24 t during 1988-'89 to 35.3 t during 1989-'90 and further to 92.7 t during 1990-'91.

At Tuticorin, experimental fishing in the reef area using perch traps and by SCUBA diving have shown that *Epinephelus, Lates* and *Lethrinus* inhabit the region, of which *L. nebulosus* was the dominant one. *L. nebulosus* (67 Nos.) were tagged and released in the area. SCUBA observations have indicated that *Epinephelus* prefers to maintain physical contact with strong structures and that tyre modules are not preferred. Large, concrete structures with wide openings and cavities are recommended for attracting such fishes.

At Minicoy, the reef installed in the lagoon was found partly damaged, but fishes still congregated around it. *Chromis nigrurus, Abudefduf* and *Dascyllus* were the fishes commonly found. Monitoring of the reefs installed by the Department of Fisheries, Lakshadweep has shown that although these structures were also partly damaged, fishes such as *Lutjanus kasmira, Caesio* and *Spratelloides* were available around them. A small amount of sport-fishing has developed in this area.

Finfish seed production (DF/CUL/3)

Two centres namely Pamban on the Gulf of Mannar side and Athankarai on the Palk Bay side were selected for collection of live spawners of the seabass. Although eight specimens (length range of 50-89 cm/ and weight of 5.0-7.5 kg) were collected from the wild, none of them could be reared and maintained in tanks for induced breeding experiments. Some of the large sized specimens (76.0-86.5 cm) collected during October-March were in advanced stages of gonadial maturity (stages IV to VI), thus indicating that the spawning period of seabass around Mandapam coincides with the North-East monsoon period. Smaller fish of 50 cm were either indeterminate or immature. One specimen of 78 cm collected during May 1990 was also indeterminate.

Three specimens in the size range of 72-80 cm (5-6 kg) were collected from the ponds of the Marine Fish Farm at Mandapam during May 1990, as a result of natural stocking there. These were transported to the aquarium and reared in a tank of 200 sq. ft. These were treated with Potassium dichromate solution and antibiotics (Ampicillin, Chloramphenicol) to cure them of injuries; and fed with trash fishes (sardines, sciaenids, mullets, tilapia). Live biopsy by a plastic cannula of 1 mm diameter showed that the specimen of 80 cm (4 yrs-old) was a

post-spawning male in the process of changing over to female and containing ova of not more than 0.1 mm diameter. The other two specimens of 72 and 74 cm were immature males.

Culture of the microalga *Chlorella* and the live feed rotifer *Brachionus*, essential to feed the postlarvae of seabass was simultaneously taken up. Peak production of the rotifer (0.44 million/l) was observed in an outdoor experiment after 11 days, at a salinity of 35 ppm, temperature of 27.5-30.5°C and by feeding with *Chlorella*.

Soil and water management in fish culture ponds (DF/CUL/2)

This project has not made notable progress during the year. Certain experiments were proposed, aiming at overcoming the problem of poor water supply to the culture ponds, owing to poor tidal amplitudes as well as at improving the quality of the soil in the pond for retaining water therein. But, in view of the directive from the Management Committee of the Institute, this project is terminated during the year.

CRUSTACEAN FISHERIES DIVISION

Investigations on the artisanal fisheries (CF/IP/1)

The various types of artisanal gears operated along the Indian coast was monitored during the year. The catch composition, species distribution, biology of important groups caught in the different gears were studied at the following important centres.

Karwar: The small shore seines known as 'Yendi' landed 4.93 t of prawns with a catch rate of 6 kg/unit. *Parapenaeopsis stylifera* was the dominant species (40.24%) followed by *Penaeus merguiensis* (31.87%), *Metapenaeus dobsoni* (24.76%), *M. affinis* (2.78%) and *M. monoceros* (0.35%). Among fishes *Rastrelliger kanagurta* contributed 1.129 t with a catch rate of 1.32 kg/unit and *Sardinella longiceps* 0.375 t with a catch rate of 0.44 kg/unit. The lesser sardines amounted to 0.113 t with a catch rate of 0.13 kg/unit. The total length of *S. longiceps* ranged from 65-116 mm with modes at 75 mm and 100 mm. Indeterminates formed 78% and preadults 22%. Among mackerel all stages of gonadial maturity were observed.

Mangalore: The traditional gears at this centre include the cast net, hand trawl and 'Kairampani' (shore seine). A total of 5.7 t of prawns were landed during the year by all gears at Bengare as compared to 6.3 t landed the previous year. *M. dobsoni* was the dominant species and contributed 77.2% of the prawn catch. *P. indicus* contributed the remaining 20.8% of the catch. The respective size ranges of the species were 18-73 mm and 63-103 mm.

Calicut: Ring net, 'Ayilachalavala', drift net and 'disco vala' were the different indigenous gears operated in the near shore area. Stake nets were operated in the estuarine region. Prawns and fishes (oil sardine, pomfrets and flat fishes) mainly contributed to the artisanal fishery at the centre. The total landings of oil sardine by all gears this year was estimated at 3,512 t. This is 10.5% less than that of the previous year. Of the total oil sardine landed, 66.8% was brought by the ring net, with an average CPUE of 2,117 kg. Ring nets were operated at 11-20 m and 21-40 m depth zones with greater intensity (3 times) in the latter depth. Indeterminates (50.4%) and immature fishes (49.6%) contributed to the oil sardine catch at the centre. The landings of pomfret (19.5 t) showed a 5 fold increase this year compared to the previous year. Silver pomfrets contributed 98.6% of the catch with a CPUE of 1.2 kg. Flat fishes with a catch of 13.1 t comprised 0.25% of the total landings of the ring net. *Cynoglossus macrostomus* exclusively comprised the flat fish catch. The total length of the fish ranged from 85-149 mm with modes at 115 and 135 mm.

The contribution of prawns in the ring net, 'disco vala' and stake net amounted to 16.5 t (CPUE 9.95 kg), 1 t (18.2 kg) and 282 t (30.6 kg) respectively. The stake net catch consisted mainly of juvenile prawns. The size of *M. dobsoni* ranged from 56-80 mm with mode at 71-75 mm for males and 66-105 mm with mode at 81-90 mm for females. In the stake net catch the respective size of the two sexes ranged from 31-85 mm and from 31-75 mm with a common mode at

46-50 mm. The size of *M. monoceros* ranged from 36-120 mm with a single mode at 66-70 mm for males and double modes at 61-65 mm and 86-90 mm for females. Size range of *P. indicus* was from 46-140 mm with mode at 86-90 mm in males and 81-85 mm in females.

Cochin: Ring seine was the major indigenous gear employed at Fort Cochin for fishing oil sardine, whitebaits, mackerel, sciaenids and prawns. Other gears operated were gill nets and cast nets for prawns at Puthuvyppu, stake nets, ring seines and minitrawls at Ambalapuzha. Cast net operations were restricted to monsoon months whereas other gears were operated throughout the year.

The effort in respect of ring seine at Fort Cochin showed an increase of 50% in the year 1990-'91 over the previous year. The oil sardine catch more or less remained the same but catch rate declined by 32.8% over the previous year. Mackerel recorded increase in the landings but not in the catch rate during this year. Sciaenids registered a sharp decline of more than 83% in the catch. Prawn catches in the ring seine operations at Fort Cochin were confined to a few days in the second half of June in both the years. Prawn landings in gill net and cast net showed decline at Puthuvyppu. Juvenile prawn landings by stake net operations at Vypeen bar mouth did not show variation from the previous year whereas at Thevara, the catch and catch rate increased.

The oil sardine catch at Fort Cochin amounted to 730 t at the rate of 95.7 kg/unit. Maximum landings were during the monsoon months of June to August. Total length of *S. longiceps* ranged from 65 mm to 195 mm with modes at 105 mm, 135 mm and 170 mm. The indeterminates forming 75.4% was the mainstay of the fishery. Preadults formed 13.54% while the adults formed 11.06%. Females dominated among the preadults and males among adults. Gravid gonads were present in June.

The estimated catch of whitebaits was 22 t and they were landed in June, July and September only. The fishery was chiefly supported by *Stolephorus macrops* (99.06%), followed by *S. batavlensis* (0.5%) and *S. devisi* (0.43%). The size of *S. macrops* ranged from 50 to 75 mm with a mode at 65 mm. Adults formed 55.2% of the catch. Males dominated among the preadults and adults. Gravid fishes were observed in September.

At Fort Cochin 530 t of mackerel were landed at the rate of 69.5 kg/unit. Fishery was supported by fishes ranging between 85 and 245 mm showing multimodes the major one being at 120 mm. Recruitment of younger fishes to the fishery was in June. Immature fishes contributed to the fishery during all the months except January when spent specimens dominated.

Sciaenids at Fort Cochin formed 66.5 t at the rate of 8.7 kg/unit. *Johnius sina* was the dominant species (91.64%) followed by *Otolithes cuvieri* (7.49%), *O. ruber* (0.64%) and *Kathala axillaris* (0.22%). The size range of *J. sina* was 85-185 mm with a dominant mode at 125 mm. Gravid and spent females dominated during July and August.

The gill nets at Puthuvyppu landed 6.4 t of prawns. *P. indicus* dominated (94.5%) and was followed by *P. stylifera* (3%), *M. dobsoni* (2.04%) and *P. monodon* 0.61%). In monsoon months *P. indicus* fishery was supported by larger prawns in the size of 136- 165 mm. Spawners were totally absent. Cast nets at Puthuvyppu landed 1,024 kg of prawns at the rate of 0.33 kg/unit. The species contributing to the fishery were *P. monodon* (50.5%), *P. indicus* (33.6%) and *M. affinis* (15.9%). Ring seines at Fort Cochin landed 51 t of *P. indicus* in

the third week of June. The size ranged from 134-183 mm with the modes at 138 mm and 153 mm for males and 143 mm and 168 mm for females. The ring seines at Ambalapuzha landed 226.3 t of prawns at the rate of 7.9 kg/unit. *M. dobsoni* (53%) dominated followed by *P. stylifera* (47%). Maximum landings were in June 1990 and February 1991. Size range for *M. dobsoni* was 51-101 mm for both the sexes with the modes at 81-85 mm for males and 86-90 mm for females. Size range for *P. stylifera* was 51-100 mm with the mode at 76-80 mm for males and 51-103 mm with the mode at 76-80 mm for females.

The minitrawls at Ambalapuzha recorded 327.1 t of prawns at the rate of 9.7 kg/unit. This gear was not operated during monsoon. *P. stylifera* (51.2%) and *M. dobsoni* (48.8%) contributed to the fishery. The size ranges for *P. stylifera* were 50-95 mm with the mode at 66-70 mm for males and 45-121 mm with the mode at 71-75 mm for females. The size range for both the sexes of *M. dobsoni* was 51-101 mm but the modes were at 81-85 mm for males and 86-90 mm for females. Mature females of *M. dobsoni* formed 28% in minitrawls and 40% in ring nets while in *P. stylifera* they formed 31% in the former gear and 22.6% in the latter.

Stake nets in the backwaters at Vypeen bar mouth landed 185.3 t of prawns at the rate of 5.2 kg/unit and both the catch and catch rate remained the same as those of previous year. *M. dobsoni* (65.5%) dominated and was followed by *P. indicus* (16.83%) and *M. monoceros* (15.5%); *P. stylifera* caught in June only, formed 2.4% of the annual prawn catch. The stake nets operated in the backwaters of Thevara landed 225.4 t of juvenile prawns at the rate of 4.3 kg/unit. Despite reduction in the number of units, the catch recorded an increase of 45.3% and the catch rate by 65.4% from that of last year. The species contributing to the fishery were *M. dobsoni* (72.8%), *M. monoceros* (14.8%) and *P. indicus* (12.4%). Size range of *M. dobsoni* was 26-95 mm at both the centres. Both the sexes showed one dominant mode at each of the centres. It was at 48 mm at Vypeen and 53 mm at Thevara. The size range of *M. monoceros* was 56-115 mm. The dominant modes at Vypeen were 73 and 83 mm for males and 78 mm for females and at Thevara 78 mm for males and 83 mm for females.

Vizhinjam: The artisanal gears operated from this centre include the hooks and lines operated from motorised and non-motorised crafts, boat seine, shore seine, 'Kochuvala', 'Chala vala' and 'Netholi vala'.

Tunas were mainly landed by the hooks and lines and the catch (1,306 t) formed 47.2% of the total tuna catch. The effort expended by hooks and lines from motorised crafts increased during the year and it resulted in a consequent increase in tuna landings. The catch rate of tunas in the motorised hooks and lines was significantly higher than that of the non-motorised units. In the motorised units *Auxis rochei* dominated the tuna catch (74.6%) followed by *Euthynnus affinis* (20.4%), *Thunnus albacares* (2.6%), *Sarda orientalis* (1.1%), *Auxis thazard* (0.8%) and *Katsuwonus pelamis* (0.5%). In hooks and lines operated from non-motorised crafts *E. affinis* (78.1%) dominated followed by *A. rochei* (16.7%), *S. orientalis* (3.4%) and *A. thazard* (1.7%).

The total mackerel catch in the artisanal gears amounted to 112.5 t. This formed 18.3% of the total mackerel catch by all gears at the centre. Juveniles of mackerel (100-150 mm) were observed in the shore seines during November-December. An estimated 187 t of anchovies were landed by the artisanal gears. Boat seines contributed 67.8% of the catch followed by 'Netholi vala' (26.9%). In the boat seine, *Encrasicholina*

devisi dominated (47.1%) followed by *Stolephorus waitei* (43.7%), *S. andhraensis* (7.8%) and *E. punctifer* (0.7%).

The artisanal gears landed 201 t of perches with peak landings during December and January. Hooks and lines operated from motorised crafts contributed 91.4% with a CPUE of 10.18 kg. At Muttom 88.8 t of perches were landed. Lethrinids formed the bulk of the catch (74.8%) followed by lutianids (16.8%), nemipterids (6.6%), sciaenids (1%) and goat fishes (0.85%).

Tuticorin: Bottomset gill net, prawn gill net, 'thallumadi', sardine gill net and shore seine were the artisanal gears operated here.

Lesser sardines totalling 2,060 t were landed by sardine gillnets. *Sardinella gibbosa* was the dominant species forming 48.5% of the total lesser sardine catch. The size range of *S. gibbosa* was from 9.5 to 17.0 cm and the dominant mode was at 13.3 cm. All stages of maturity were encountered in the catch.

Shore seines landed 102 t of *Stolephorus* spp. *S. indicus* was the dominant species followed by *S. bataviensis* and *S. devisi*. Size ranges of *S. indicus*, *S. bataviensis* and *S. devisi* were 5.0-15.0 cm, 4.0-9.5 cm and 5.5-8.5 cm respectively. Fishes in indeterminate stage only contributed to the fishery.

Gill nets landed 25 t of *P. indicus* at the rate of 4.9 kg/unit and 'thallumadi' landed 3.3 t of prawns at the rate of 2.8 kg/unit in which *P. semisulcatus* was the dominant species. Mature *P. indicus* was encountered throughout the year except November.

Bottomset gill nets landed 83 t of crabs. *Portunus pelagicus* was the dominant species constituting 98.6% of the landings. The rest was contributed by *Scylla serrata*. The size range of male *P. pelagicus* was 121-150 mm and that of female was 111-125 mm.

No clear relationship could be established between the various environmental parameters and the fish landed. The oxygen content was maximum in April (5.3 ml/l) during which maximum landing of crab *P. pelagicus* was recorded by bottomset gill nets off Tharuvaikulam. The primary production was maximum (531 mg C/m^3) in November when the crab landing was also high (10.6 t).

Mandapam Camp: Lesser sardine landings during the year was estimated at 493 t with the CPUE of 558 kg at Mandapam and 406 t with the CPUE of 60.4 kg at Pamban. The catches improved by 208% at Mandapam and by 128% at Pamban as a consequence of the increase in effort when compared to last year. The lesser sardines formed 86.9% of the fish catch by 'choodai valai' units. *S. albella* and *S. gibbosa* were contributing to the fishery. The former formed 68.92% at Mandapam and 59.94% at Pamban. Size range of *S. albella* was 80-150 mm at Mandapam and 90-145 mm at Pamban and of *S. gibbosa* was 70-155 mm and 100-150 mm respectively. The supporting group was 110-135 mm for *S. albella* and 110-140 mm for *S. gibbosa* at both the centres. Recruitment of *S. albella* to the fishery started in June at the size of 80 mm and of *S. gibbosa* from August-September at 85 mm. Crab landings were estimated at 125 t at the landing centres, Vedalai and Devipatnam. *P. pelagicus* was the main species followed by *S. serrata*. The size range of male *P. pelagicus* was 80-159 mm and of females was 75-164 mm.

Only 2.3 t of prawns were landed at the centre with a CPUE of 0.27 kg. *P. semisulcatus* was the only species contributing to the fishery by 'Thallu valai'. The size range was 82-165 mm for males and 82-158 mm for females.

Lobsters landed at Vedalai amounted to 2.6 t with a CPUE of 0.25 kg. The catch increased by 44.4% over that of the previous

year. *Panilurus ornatus* (82.1%) and *P. homarus* (17.9%) were the two species that contributed to the fishery.

Madras: Prawns and crabs appeared in gill net catches at Nochikuppam during October-March. The estimated catch of prawns was 5.2 t and of crabs was 1.97 t. The prawn fishery was mainly supported by *P. indicus* (94%) while the rest was comprised of *P. monodon* and *P. semisulcatus*. During the peak monsoon month (November) a shoal of *P. indicus* appeared for 2-3 days and a high catch rate 10 kg/day was obtained. The prawns measured 126-165 mm in size and fetched about Rs. 150/kg.

Juvenile prawns were caught from the Ennore Estuary mainly by stake nets and to a smaller extent by cast nets and drag nets. A total catch of 177.6 t of prawns formed 89.7% of the catch by stake nets recording a catch rate of 30.27 kg/unit/day. *M. dobsoni* (32.5%), *P. indicus* (31.6%) and *M. monoceros* (21.0%) were dominant species. *P. monodon* and *P. semisulcatus* occurred in smaller numbers. *P. japonicus* an uncommon species was observed during January-February. Prawns caught in the cast net comprised of *P. indicus* (77.6%), *M. monoceros* (12.3%) and *M. dobsoni* (10.1%). The drag net landed *P. indicus* (81.47%), *M. monoceros* (23.1%) and *M. dobsoni* (16.3%).

The 'FAO gill net' called 'Trammel-net' landed lobsters all along a stretch of about 30 km between Kovalam in the north and Mahabalipuram in the south. A total of 3.58 t of lobsters at an average rate of 1.85 kg/unit/day was estimated at Kovalam. *P. homarus* (75.2%) formed the bulk and the rest was comprised of *P. ornatus* and *P. versicolor*.

P. polyphagus occurred in stray numbers only.Size range of the male *P. homarus* was 141-250 mm while of the female was 131-150 mm. In October 83.3% of the females were in berried condition.

The gill net and 'pannu valai' together landed 763 kg of sciaenids for a very low catch rate.

Kakinada: The artisanal gear used at Uppada near Kakinada are gill nets of various mesh sizes. They are locally called 'disco net' 'nara vala', 'pora vala', 'jogavala', etc. Combination of two types of these gill nets were used for fishing. The estimated catch by these gears was 301 t for the year. Mackerel (33.1 t) formed 11% of the total fish catch. Peak landings of mackerel was during January to March when nearly 96% of the annual catch was landed. The size of mackerel in commercial catch ranged from 150-240 mm.

Shore seine (593) units landed 49.6 t of fish and mackerels formed 726 kg (1.5%). Boat seines ('Iraguvala') landed 783 kg and hooks and lines landed 2 t of fish and mackerel was totally absent in these gears.

Visakhapatnam: The artisanal gears in use include shore seines, boat seines and gill nets (below 45 mm mesh) and the catches landed by these were 13 t, 95 t and 90 t at the catch rate of 37 kg, 20 kg and 22 kg respectively. Lesser sardines formed the dominant catch followed by ribbon fishes, oil sardine, *Dussumieria* and silverbellies.

Bulk of the oil sardine catch was landed by boat seine (90%).It amounted to 21.1 t and formed 22.2% of the boat seine catch. Gill nets landed 2.3 t of oil sardines while shore seine landed none. Oil sardines were available only during May-September. The size of oil sardine landed by boat seine ranged from 70-175 mm with modes at 95 mm and 160 mm. The size range for the fish landed by gill net was 145-195 mm with modes at 150 mm and 180 mm.

Of the 3 t of mackerel landed over the year, 14% came from boat seines and

86% from gill nets. Boat seine landed 425 kg of *R. kanagurta* forming 0.5 % of the fish catch by this gear. Gill net landed 2.7 t of *R. faughni* forming 3 % of the catch by it. *R. kanagurta* had a size range of 75-170 mm with the modal size at 150 mm and *R. faughni* had a size range of 110-180 mm with modes at 115, 140 and 160 mm. Catches of both the species of mackerel comprised entirely of juvenile fish.

Puri: Gill nets at Pentakota in Puri landed 88.3 t of penaeid prawns at the rate of 0.3 kg/hr. There was a marginal increase in the catch and marginal decrease in the catch rate when compared with the same of last year. Nearly 72% of the annual landings came in November alone. *P. indicus* (64 %) dominated the catch followed by *P. merguiensis* (26.1 %), *M. affinis* (7.4%) and *P. monodon* (2.0 %). Size range of male *P. indicus* was 113-168 mm and of females was 113-193 mm. In *P. merguiensis*, the size range of the males was 123-173 mm and of females was 123-198 mm, the mainstay of the fishery was formed by the group 132-165 mm in the former and 148-173 mm in the latter. Size range of male *M. affinis* was 88-158 mm and of females was 83-188 mm. Spawning was observed throughout the year in all the three species.

Bamboo traps operating in Chilka Lake landed 54.4 t of penaeid prawns at the rate of 0.03 kg/trap. The catch showed decline from that during the previous year. *P. monodon* (39%) dominated and was followed by *M. monoceros* (27.35%), *P. indicus* and *M. dobsoni* (10.65 %). Size range of male *P. monodon* was 105-235 mm and of females was 85-245 mm. Prawns having a size of 125-185 mm for males and 135-205 mm for females was the mainstay of the fishery. In the case of *P. monoceros*,the size range for males was 38-103 mm and for females was 38-123mm while the mainstay of the fishery was formed by 58-88 mm group for both the sexes. The size range of male *P. indicus* was 63-148 mm and of females was 68-153 mm and the mainstay of the fishery was formed by 98-138 mm group for both the sexes.

Sea ranching of marine prawns (CF/CUL/1.1.7)

During the period under report, 21 trials were carried out at Mandapam Camp for the production of seed of the green tiger prawn *P. semisulcatus* on a mass scale. A total of 1.16 million post larvae-I were produced which were further reared in the nurseries for another 10 to 25 days. The seed produced were used for sea ranching and for conducting culture experiments in the farms belonging to the Tamil Nadu State Govemment. Some post larvae were further grown to juvenile stage for the purpose of tagging and releasing into the sea to study the migration and the effect of sea ranching on the commercial fishery.

A total of 5,74,062 seed (PL 10-25) of *P. semisulcatus* were released into Palk Bay, off Mandapam under the sea ranching programme. Seed measuring 17 mm in total length and numbering 6,000 were supplied for stocking at the Pulicat farm near Madras. Further, 18,000 seeds measuring 15.6 mm and 2,500 seeds measuring 30.7 mm in total length were supplied for stocking in the Mannamunai farm near Devipatnam.

Hatchery reared seeds measuring on an average 19.3 mm in total length were stocked in the Departmental farms for growing into juveniles for tagging purpose.

The laboratory reared seeds of *P. semisulcatus* registered an average growth rate of 1.35 mm/day for the first 50 days. Within 113 days they reached a mean size of 95.8 mm in total length with an average weight of 7 grams. Growth rate was relatively less after 81 days due to poor quality of water in the ponds. Yet the survival

was 60% on the 113th day when they were harvested for tagging.

A total of 2,924 tagged prawns were released into the sea at a depth of 2.5 to 3 fathoms. Recovery of tagged prawns from the commercial catches at a depth of 4.5 to 7 fathoms started 4 days after their release.

Evaluation of the fishery resources exploited by large trawlers (CF/IP/2)

Large trawlers did not operate at Cochin during April 1990 - March 1991. During this period due to some disputes between the crew and the operators, only 25 trawlers started operating at Visakhapatnam from 15th July and the rest from 15th August. Fishing logs from here for the period April 1989 to March 1990 are being obtained from the trawlers for analysing the catch data.

MOLLUSCAN FISHERIES DIVISION

Studies on clam, mussel and gastropod resources (MOL/RE/2)

The clam production in the Kakinada Bay has been estimated at 2,974 t, mainly contributed by blood clam *Anadara granosa* (71%) and the rest made up by *Meretrix casta*, *M. meretrix* and *Paphia malabarica*. The clam beds in the Pulicat Lake were adversely affected by dredging operations carried out by the Ennore Thermal Station. The clam species recorded here include *A. granosa*, *Katelysia opima* and *M. meretrix*. The annual production of the black clam *Villorita cyprinoides* in Nettur-Kannamaly area of the Vembanad Lake was 387 t and that of *Meretrix casta* in the Mulki Estuary was 354 t. Over 5,000 t of the marine clam *Sunetta scripta* were exploited from Munambam-Murukkumpadam area near Cochin, exclusively for the shell.

The estimated brown mussel production at Vizhinjam-Mulloor-Pulinkudi area was 825 t. Peak landings were observed during September-December. Spatfall along the coast was during the post-monsoon period. A bed of green mussel having an area of 7.5 ha was recorded near the mouth of Mulki Estuary.On the other hand, mass mortality of green mussels was observed during November in the Ennore Estuary due to the inflow of sewage and other pollutants.

The annual chank production along the Tuticorin-Thiruchendur coast was estimated at 1,31,300 chanks, 63% of which were full-sized. Along Ramanathapuram coast nearly 80,200 chanks were landed, 56% of them being full-sized. Egg capsules of chanks were reared in the laboratory at Mandapam Camp. Baby chanks having an initial length of 17 mm grew to 34 mm in a period of five months.

Development of hatchery technology for experimental/mass production of the seed of gastropods, clams,mussels, edible oyster,pearl oysters and cephalopods, and sea ranching of clams and pearl oysters (MOL/CUL/4)

In the hatchery-based seed production system at Tuticorin, 9,55,500 seed of the edible oyster *Crassostrea madrasensis* were produced with a settlement rate of 0.3 to 9.3% per day. Spat settlement was higher on oyster shells treated with calcium oxide and oyster shell liquor when compared to untreated shells. Over 3,000 edible oyster seed produced in the hatchery were supplied to the Department of Fisheries, Government of Gujarat. The seed were successfully transported by road and air from Tuticorin to Sikka in 39 hours with 95 % survival.

Over 2,54,000 seed of the pearl oyster, *Pinctada fucata* were produced at the Tuticorin hatchery. Of these, 20,000 seed were sea-ranched over the pearl banks off Tuticorin in the Gulf of Mannar. Attempts made to locate the ranched pearl oysters did not succeed. SCUBA diving indicated the presence of *P. fucata* at Pulipundu and Kudemuthu paars. The

surveys conducted indicate a possible revival of the pearl beds in the near future, but to what extent the sea ranching programme is responsible for the revival is yet to be assessed.

Of the 45,875 seed of the clam *Paphia malabarica* produced in the Tuticorin hatchery, 35,000 clams were ranched in the Korampallam Creek and the Pulicat Lake.

In the microalgae culture laboratory at Tuticorin, mass cultures of *Isochrysis galbana* and *Chaetoceros calcitrans* were maintained. The former was used to feed the bivalve larvae and the latter to feed the oyster spat produced in the hatchery.

At Calicut, broodstock of the green mussel *Perna viridis* maintained in the hatchery were induced to spawn through mechanical stimulation. The larvae thus produced were reared for ten days, upto the umbo stage. Broodstock was maintained in a healthy condition by keeping the algae *Enteromorpha* and *Caulerpa* in the tanks.

Sexually ripe top shell, *Trochus niloticus* having a shell diameter of 100 mm was bred in the laboratory of C. A. R. I., Port Blair. The fully developed ova measured 210µ and had a jelly layer around it. Fertilization was complete in one hour and the trochophore stage was reached in six hours. The larvae were reared upto veliger stage when they developed rudiment of the shell.

Investigations of the factors affecting cultured pearl production (MOL/CUL/6)

Pearl oysters were maintained in three rafts at the Tuticorin Harbour Basin farm. A total of 500 pearl oysters were operated during September-October 1990 and 4 mm and 5 mm nuclei were implanted. The gonads of all the oysters operated were in the spent resting stage. After a period of five months 78 oysters were harvested. A total of 35 cultured pearls were obtained, of which A grade pearls formed 9%, B grade 11%, C grade 40% and D grade 40%.

Several sea trips were made to locate suitable sites for mooring pearl culture rafts. Valinokkam Bay in the Gulf of Mannar was found to have ideal conditions for establishing pearl culture farm.

Edible oyster culture (MOL/CUL/7)

The hatchery produced spats of the edible oyster, set on shells, were reared for two to three months in the coastal pond and then in farm. Study of survival rates of oysters in different culture methods indicated that the highest (99.6%) was in box culture method, followed by stake culture method (93%), ren method (80%) and the lowest (68%) in bottom culture method. The oyster grew to 76 mm in nine months in the ren method.

In Pulicat Lake, 30,000 oyster spat were collected using oyster shells as spat collectors during May-June 1990. They were reared to a mean size of 79 mm by March 1991 by the bottom culture method. The growth rate was fast during January-March when environmental conditions were favourable and slow during October-December when salinity and water temperature decreased.

The oyster resources from Athankarai to Thengapattinam in southern Tamil Nadu and between Pulicat and Kakinada in Andhra Pradesh were surveyed. Rich oyster beds have been recorded for the first time in Pulicat, Kandleru and Pennar Estuaries. The estuaries are suitable for oyster culture as they have perennial connection with the sea.

FISHERY ENVIRONMENT MANAGEMENT DIVISION

Investigations on environmental parameters in inshore waters in relation to fisheries (FEM/ES/1)

Cochin: Hydrography data collected from the inshore fishing grounds off Cochin revealed following features especially at the 20 m station. Surface temperature increased from 29.57°C in April to 30.17°C in May. With the onset of monsoon the temperature declined steadily from June to August (27.69 to 24.62°C). From September to March the temperature gradually increased (25.15°C to 29.23°C). Surface salinity was around 35 ppt in April 1990 and decreased to 29.73 in August and increased to 35 ppt in October. In the subsequent months the values ranged from 33.75 to 34.64 ppt. Oxygen content which was 3.39 ml/l in April declined to 1.88 ml in August and increased gradually to 4.15 ml/l in February 1991. It was observed that in August 1990, the height of the column of upwelled water was the maximum and the extent of land drainage at the surface was farthest from the shore during the same month.

Average net primary production during the 1st, 2nd, 3rd and 4th quarters were respectivley 0.677, 0.724, 0.711 and 0.755 g C/m^3/day. Net production was higher in the 10 m station compared to 20 and 30 m stations.

The total bacterial count in the inshore waters ranged from 1.2 to 6.9 x 10^6/g and 2.9 to 8.2 x 10^6/ g in the sediments. The population of fungi in the waters ranged from 0.6 to 2.1 x 10^3/ ml.

Coral reef micro-organisms were analysed for qualitative and quantitative distribution from Manauli Island (off Mandapam) to understand their role in organic recycling, biogeochemical cycling, secondary production and in nitrogen fixation. The count of aerobic heterotrophs ranged from 3.9 x 10^6/g in *Acropora formosa* to 6.2 x 10^7/g in the case of *Goniastrea retiformis*. Most of the strains reduced nitrate and sulphate which showed active metabolism in the area and the presence of sulphate ions and sulphide precipitation which can kill the internal reef community through anaerobiosis and H_2S poisoning.

Studies on the zooplankton population of the coastal waters off Cochin were conducted during the year 1990-'91. Weekly zooplankton samples were collected using Bongo 20 net from the fishing grounds off Cochin from four stations namely, Aspinwall, 10 m, 20 m and 30 m depth zones. The monthly mean values of biomass and numerical abundance of the different groups and the larval forms were estimated per 100 m^3 of water filtered.

The zooplankton population consisted of cladocera, copepods, lucifers, decapod larvae, doliolids, chaetognaths, siphonophores, fish eggs and larvae, molluscan larvae and polychaete larvae in large numbers at one time or the other.

The monthly mean displacement volume ranged from 0.60 to 58.90 and the volume of 58.90 ml/100 m^3 recorded in

September at 30 m depth zone was the highest. The numerical abundance of the different groups and larval forms also reached the peak in September. Generally, the coastal waters off Cochin were rich in zooplankton population in the 10-13 m depth column during September-October and the highest abundance occurred in the former month. Copepods, cladocerans, doliolids, siphonophores, chaetognaths, amphipods, fish eggs and larvae, polychaetes, euphausids, ctenophores, medusae, appendicularians and molluscan larvae were the zooplankters observed to attain the peak of abundance during September-October.

Among the cladocerans, swarming of *Penilia avirostris* was observed in September, November and March at 10 and 20 m depth zones. The concentration of fish eggs at 11,505/100 m^3 and larvae, 574/100 m^3 recorded in a sample from the 10m depth zone during the second week of September was the highest for the period under review. Swarming of *Doliolum gegenbauri* var. *tritonis* alongwith those of *Penilia avirostris* and *Fragilaria oceanica* was remarkable in the same depth zone during September. A large number of scyphomedusae, *Pelagia noctiluca*, was encountered for the first time in the coastal waters at 30m depth zone in September and it contributed to the high volume observed during that month. A high concentration of lucifera, 83,294/100 m^3 was observed in the second week of January at the 30m depth zone. Ostracods and medusae occurred in large numbers during April.

Stomatopod larvae were very common during the premonsoon and postmonsoon months. Larval decapods were abundant in the different depth zones during February-March, May and November and the maximum number 13,741/100 m^3 occurred in the port mouth area during May.Sergestid larvae formed the chief component of larval decapods and the larvae of lucifers were highly abundant during May, August, November-December and January-March and those of *Acetes* sp. during September and January-March in the 10-30m depth zones. Penaeid larvae were preponderant during November- December and January-March at 20-30m depth zones. Larval decapods belonging to families of alpheidae, hippolytidae, pasiphaeidae, paguridae, callianassidae, porcellanidae, albuneidae, hippidae, pinnotheridae, leucosiidae and brachyuridae were also observed during the year.

Among the pteropods *Creseis acicula, Desmopterus papilio, Cavolinia uncinata pulsata* were common during the period but were abundant in the deeper zones during September, November and February.Isopods and a few actinotrochs occurred occasionally. Foraminifers, larvae of cirripedes, cyphonautes and brachiopods also appeared in appreciable numbers. Among the larvae of echinoderms, echinoplutei and ophioplutei were more abundant than auricularia.

Blooms of *Noctiluca miliaris surtray* in June, *Chaetoceros* sp. in August and *Coscinodiscus* sp. in February were observed. Dense blooms of *Fragilaria oceanica* appeared at 10 m and 30 m depth zones during September.

Bombay: Monthly mean values of temperature, pH, Dissolved Oxygen and salinity were observed in the range of 22.5°C to 31.5°C; 8.10 to 8.30; 3.76 to 5.75 ml/l and 35.46 to 36.17 ppt respectively. The average volume of zooplankton ranged from 51.58 to 135.75 ml/ 100 m^3.

Karwar: In the 8 m station, surface temperature ranged from 26.8 to 30.3°C; salinity 27.7 to 37.2 ppt and dissolved oxygen 3.61 to 5.39 ml/l. In the 16m

station, temperature ranged from 27.0 to 30.0°C, salinity 29.6 to 36.4 ppt and dissolved oxygen 3.96 to 5.39ml/l.

Mangalore: Water temperature ranged from 25.3°C in September to 33.5°C in April. Salinity decreased from April to July,then gradually increased till November-December and then remained almost stable. Higher volumes of dissolved oxygen content was noticed in monsoon months and the volumes ranged from 2.72 ml/l in November to 5.14 ml/l in July. The lowest value of alkalinity was also recorded in the month of July, amounted to 73.82 mg/l as $CaCO_3$ and the net primary productivity varied from 12. 86 to 894.05 mgC/m^3/day.

Calicut: Temperature varied from 30 to 31°C, dissolved oxygen 4.27 to 4.9 ml/l and net primary production varied from 120 to 394.7 mg C/m^3 during summer months.

Vizhinjam: Surface temperature ranged from 23°C (August) to 30°C (April). Salinity did not show much variations (33.96 to 35.3 ppt). Dissolved Oxygen (D.O.) varied from 4.70 to 5.14ml/l. Zooplankton volumes ranged from 3.2 (April) to 30.0 (June).Copepods, chaetognaths, decapod larvae and fish eggs were the dominant groups observed in the plankton. Copepods had peak abundance during June, July and September.

Tuticorin: Surface temperature ranged from27.6 (August) to 30. 6°C (May). Dissolved oxygen varied from 3.98 to 5.36ml/l. Salinity ranged from 32.08 (January) to 35.98 ppt (May). The values of phosphates and silicates were observed to be high during August- September. Primary production ranged from 132 to 590 mgC/m^3/day during different months of the year. Zooplankton volumes ranged from 5.0 ml (July) to 125.0 ml (September). In the order of abundance copepods, lamellibranchs, stomatopods, chaetognaths, mysis, decapod larvae, medusae and appendicularians were the dominant constitutents. Benthic fauna in the fishing grounds had more organisms in October and less number in March.

Mandapam Camp: In the Gulf of Mannar salinity ranged from 39.95 to 33.15 ppt, dissolved oxygen from 3.29 to 4.03 ml/l and in Palk Bay salinity ranged from 29.11 to 30.90 ppt and dissolved oxygen 3.07 to 4.80 ml/l during January to March.

Madras: Sea surface temperature ranged from 25 to 29°C during different months. Salinity values were low during November-January (21.00 to 24.60 ppt) to 32.76 to 36.60 ppt) in summer months. Swarming of copepods, lucifer, doliolum, sagitta and abundance of fish eggs were observed during February and March indicating higher secondary production. Catches from artisanal fishing increased during this period.

Visakhapatnam: Intensive upwelling was indicated during April '90, subsided during May-June and again revived in July. Indications of upwelling was again observed during March 1991 in the nearshore surface water. Nutrients, productivity and pigment concentration recorded higher values in the Harbour stations.

Marine pollution in relation to protection of living resources (FEM/MP/1)

Cochin: Fortnightly sampling and analysis of water, sediment and biological samples were covered from the estuarine and inshore waters. Salinity distribution showed wide fluctuations. In the estuarine area the lowest value of 0.31 ppt was recorded in July and the highest value of 34.41 ppt in February. However, in the month of July, while the surface salinity ranged from 0.31 to 17 ppt the bottom salinity showed a range of 32.94 ppt to 35.57 ppt probably indicating

upwelling. Inorganic phosphate levels were high during pre-monsoon season, compared to other periods. Nitrate and ammonia levels were high during monsoon period (June-July), but moderate during other periods.

Chlorophyll levels showed higher ranges during April-May and October-November. Relatively low levels were recorded during January and February.

Metal levels in sediment samples did not show any significant variations, except that Lead (Pb) levels were rather high during monsoon period (June-September); the highest value recorded was in July (45.5 to 69.5 ppm dry weight).

Heavy metal levels were estimated in ten varieties of bilogical samples including fin fishes, prawns, crabs and bivalves. The highest levels were detected in bivalve (*Sunetta scripta*) followed by crabs *Neptunus* sp.), prawns and fin fishes. Among three species of prawns tested, *M. dobsoni* contained higher levels compared to other species. However, metal levels detected were below the levels recommended for seafood export.

Karwar: Mussels collected from a relatively clean environment were transplanted using nylon bags along a pollution gradient near the caustic soda plant (one close to the impact area, one away from the point and third one in a clear area as control). Comparatively higher concentration of copper, zinc, cadmium and lead was observed in the whole tissue of mussels kept for three months near the discharge point, compared to control mussels. Except for lead, kidney was found to be a major site for metal uptake. The order of metal concentration in the whole body of mussels were as follows, Zn-Cu-Cd-Pb.

The oxygen consumption, ammonia excretion and filtration rate of mussels were also measured to assess the physiological responses of transplanted mussels. Mussels kept near the discharge point showed relatively lower scope of growth.

Tuticorin: Data were collected for hydrography, primary production and other parameters from the impact area. Laboratory experiments were carried out to study the uptake of heavy metals using water from the impact zone. Three experiments were conducted using edible oyster (*Crassostrea madrasensis*), prawn (*Penaeus indicus*) and mullet (*Liza macrolepis*).

Two sets of experiments were conducted using edible oyster exposing them to water from impact zone, bay water and clean sea water. The experiments were conducted for 77days and 125 days respectively. It was observed that the accumulation of metals, particularly zinc and lead was high in the spat than the bigger ones. From the other experiments it was observed that the rate of accumulation was lower in mullets compared to that of prawns.

The qualitative studies of phytoplankton revealed the dominance of dinoflagellates, phytoflagellates and tintinids and less abundance of diatoms at the discharge point of effluents, in the premises of fly ash storage and also in the adjacent bay waters. The rate of primary production was also found to be very low in the bay waters as well as at the dicharge point of effluents. Culture experiments conducted using nanoplankters (*Isochrysis, Dicarteria, Tetraselmis and Chaetoceros*) indicated certain adverse effects of water contaminated with fly ash such as inhibitory and stimulatory effects on their growth and survival.

Environmental ecology of coastal zone and mapping of potential sites for sea farming (FEM/ES/5)

During the year, seasonal and diurnal studies on hydrography, primary productivity and other parameters were made in the coastal water bodies around Chandragiri, Nileswar, Mopla Bay, Murat, Anthakaranazhi, Thottappally and Kayamkulam. A preliminary survey was also conducted around Kakinada, Machilipatnam and Ongole. Mean salinity values at Chandragiri, Nileswar and Murat were less than 2 ppt during peak monsoon months whereas the values ranged from 19-27 ppt in Mopla Bay. During summer months the former estuarine system had salinities in the range of 25-35 ppt while Mopla Bay had 31-35 ppt. Surface temperature at the above centres ranged from 25.3 to 27.5°C in July and 28.9 to 33.0°C in March. Dissolved oxygen values had lower values in March and higher values in July. Net primary production ranged from nil value to 1.12 gC/m^3/day. At Dharmadam a location around Moidupalam was observed to be suitable for edible oyster culture and the area between Kozhaad and Dharmadam was found suitable for prawn culture. Along the Andhra coast the value of salinity ranged from 10-30 ppt in Kakinada Bay; 11.5-31.2 ppt around Machilipatnam and 3.55-12.90 ppt around Ongole. Some of these areas indicated good prospects for aquaculture.

Resource assessment of seaweed and their culture (FEM/SW/1)

Seaweed resources of Tamil Nadu coast

The deep water seaweed resources of Sector IV, Kilakkarai-Dhanushkodi was conducted during December 90 and January 91 in collaboration with the Marine Algal Research Station (CSMCRI), Mandapam. An area of 415 km^2 between Appa Island and Dhanushkodi was covered. Totally 166 stations were sampled in 13 transects at depths ranging from 5 to 21 m. Out of 166 stations, vegetation occurred only in 12 stations. Totally 29 species of marine algae were recorded, 8 species belonging to green algae, 7 to brown algae, 13 to red algae and 1 to blue-green algae. Only one species of seagrass *Cymodacea serrulata* was recorded. The hydrological data were also collected during this survey.

The data collected during 1989-'90 from the deep water seaweed resources from the Sector III Valinokkam-Kilakkarai and Mandapam-Kanyakumari were computed and report was prepared. There was no vegetation in the whole area (152.5 km^2) surveyed between Manapad and Kanyakumari. The total standing crop estimated was 5,962.5 t (wet weight) for 200 km^2 area surveyed from Valinokkam to Kilakkarai. Totally 33 species of algae (8 to Chlorophyta, 8 to Phaeophyta and 17 to Rhodophyta) and one species of seagrass *Halophila ovalis* occurred in this region.

Seaweed culture work at Minicoy

Field cultivation of *Gracilaria edulis* and *Gelidiella acerosa* was carried out in the lagoon at Minicoy from March to June '90 at four sites namely Helipad, Lighthouse, Fisheries Jetty and Navodaya School area. The seed material of *G. edulis* collected from Kavaratti Island and Mandapam area was introduced on coir rope nets and longline coir ropes. The seed material of *G. acerosa* was collected from the intertidal region in the sea side and subtidal region in the lagoon near Wiringli Island and introduced on coir rope nets, longline coir ropes and coral stones. The seed material of *G. acerosa* pretreated for 24 hrs with five growth hormones separately namely Ascorbic acid, Gibberellic acid, 3-Indole acetic acid, Kinetin and Naphthalene acetic acid at 100 mg/l concentration, was also introduced.

The growth of *G. edulis* at Fisheries Jetty and Lighthouse area was very good and the seedlings reached harvestable size after 45 days or 60 days growth. The remnants of the plants left on the nets and longline ropes after the first harvest were allowed to grow further and a second harvest was also made after another 60 days. A part of the harvested material was again utilised as seed material for culture work and it attained harvestable size in 60 days. A maximum yield of seven-fold increase over the seed material was obtained after 60 days in these experiments. Some quantity of the harvested crop was also broadcasted in the seaweed bed near Fisheries Jetty culture site for its establishment and also for laboratory culture. The growth of *G. edulis* near Helipad and Navodaya School area and *G. acerosa* (untreated and treated with hormones) in all four culture sites were affected by heavy sedimentation and epiphytic growth of several algae viz. *Lyngbya confervoides, Phormidium* sp., *Chaetomorpha aerea, Cladophora fascicularis, Ceramium* sp., *Polysiphonia* sp., *Acanthophora spicifera, Leveillea jungermannoides, Jania capillacea* and *Hypnea valentiae*. As the sea had become rough by the middle of May, except at the Fisheries Jetty, in other three places the experiments were discontinued in the second week of June. Young plants of *Sargassum duplicatum* alongwith their substrates and some quantity of harvested crop of *G. edulis* were introduced in the Artificial Reef structure near Wiringli Island for their establishment in attracting fish and other organisms, but it was not successful.

The growth of *G. edulis* at Navodaya School and Fisheries Jetty was good in the postmonsoon season. After 66 days of culture 7.1 and 4.5 fold increase were observed respectively in the above places. Problems such as grazing and epiphytic growth were observed during June to September. *G. acerosa* fixed on coral stones did not show much growth. In laboratory culture experiments *G. edulis* showed good growth rate upto 60 to 70 days.

Seaweed culture work at Mandapam

At Mandapam, artificial cultivation of *G. edulis* was carried out in tuflite tanks. In general growth was more in tanks with less density of seed material. The plants remained healthy for about 35 days and thereafter they showed sings of regeneration. Also the growth rate was not uniform in different seasons.

Spore culture of *G. edulis* was attempted in running seawater in the laboratory having controlled conditions. The germlings grew from a length of 1.4-13.0 to 15.9-34.0 mm from April to August.

Results of exploratory survey of the Indian EEZ by FORV *Sagar Sampada* (FORV/SS/3)

The zooplankton collected onboard FORV *Sagar Sampada* was sorted out with different groups upto cruise 73 after estimating the total biomass. The zooplankton data obtained from the year round sampling from the north-east coast and Andaman seas were processed for the study of spatial, seasonal and diurnal abundance of total zooplankton and the various zooplankton groups. This forms the 2nd phase of study planned for *Sagar Sampada*. The data obtained will be analysed with the help of the computer and will be correlated with the environmental data wherever possible.

One significant work carried out during the year was the editing and publishing of the papers presented at the 1st Workshop on Scientific Results of FORV *Sagar Sampada*. The proceedings of the Workshop which contained 63 papers in Six Technical Sessions was published on 25th October, 1990.

Remote sensing in relation to fisheries (FEM/RS/1.1)

Under this project, sea truth data such as SST has been collected from different stations covered by FORV *Sagar Sampada* in her cruises. SST data is also collected from smaller vessels such as *Cadalmin*. SST data based on satellite imageries are also received from Space Application Centre which indicates areas of thermal gradients and areas of probable good fishing. These data are compared with Institute's data on SST and fish catches. The National Remote Sensing Agency (NRSA) is providing colour prints of satellite data on SST distribution which is utilized for interpreting grid wise information. The project is receiving equipment support from Department of Ocean Development (DOD) and NRSA. During the year, specifications for image analyser and other equipments have been finalised by a Technical Evaluation Committee and orders for the equipments have been placed.

Mass culture of unicellular algae and live food organisms (FEM/CUL/1)

Tuticorin: The mass culture of *Isochrysis galbana* was in progress. Also, whenever required, mass culture of the centric diatom, *Chaetoceros calcitrans* was also made and supplied to the hatcheries to rear the spat and juveniles of bivalve organisms. Though, the expected blooming of these microalgae could not take place due to the poor quality of the Bay waters, daily 250-300 litres of the pure cultures were supplied to the hatcheries to rear the larvae of pearl and edible oysters, clams and sea cucumbers. Regular maintenance of the stock culture and further isolation of new forms of phytoflagellates are being continued.

Mandapam: Pure culture of *Chlorella salina* is being maintained in the phytoplankton culture laboratory at 23-25°C. Mass culture of *Chlorella* was tried in outdoor fibre-glass tanks using enriched seawater. Different experiments were conducted on the growth of *Chlorella* at different dilution, salinity and pH.

Rotifer culture (*Brachionus* sp.) are being maintained in green water in 250 l fibre-glass tanks. Different experiments were conducted to study the growth and life-cycle of rotifers in outdoor tank under a shade. The rotifer samples were maintained in seawater of different salinities such as 35, 30 and 25 ppt. The concentration of rotifers reaches a peak after 11 days of its introduction in tanks (35 & 30 ppt) with maximum cocentration of *Chlorella*.

Breeding, seed production and sea ranching of the sea cucumber *Holothuria scabra* (FEM/CUL/2)

During the year under report *Holothuria scabra* was subjected to thermal stimulation 42 times but the specimens did not spawn. On 28.8.'90 specimens in the brood stock tank on changing the sea water spawned due to the difference of 3°C. More than one million eggs were realised. This is the fifth time *Holothuria scabra* has spawned in the laboratory. The auricularia larvae appeared on the second day. The auricularia were fed on *Isochrysis galbana*. On the thirteenth day some of the auricularia transformed into doliolaria and on the 26th day some of them transformed into pentactula stage. At the end of September they settled down to the bottom of the tank. Fine sand as thin layer is provided at the bottom. Still after 33 days auricularia and doliolaria were seen. Therefore *Isochrysis* and mixed culture were given to transform them into pentactula stage and settle to the bottom of the tank. The auricularia were seen even after one month because the concentration of *Isochrysis* was found to be only five to six lakhs per ml. The bloom did not develop well for the

mixed culture due to poor quality of sea water.

Again on 10-9-'90 one male specimen spawned when the water in the brood stock tank was changed. This specimen was separated and put alongwith other large specimens but there was no response from the females.

Only 25 juveniles were produced from the spawning which took place on 28-8-'90. They have reached a maximum size of 45 mm length in six months time. All of them suddenly died due to some infection at the end of March '91. The cause for this sudden death is being investigated.

Fishery oceanography of the offshore regions (FORV/SS/1)

Analysis of oceanographic data collected during cruises of FORV *Sagar Sampada* during post monsoon months indicated two water masses with temperatures of 7-30°C (salinity 29 - 36 ppt) and (12 - 27°C (salinity 35 - 36 ppt). Salinity inversion was observed at a depth of 200-400 m during monsoon period.

Investiagations on coral reef ecosystem (FEM/EE/1)

Resurvey of coral reefs of Gulf of Mannar around Mandapam was undertaken with a view to assessing recolonisation of corals on areas where heavy destruction to reefs due to quarrying was effected. The results indicated that recolonisation is not significant even after 25 years. Work on the corals of Travancore coast is progressing.

PHYSIOLOGY, NUTRITION AND PATHOLOGY DIVISION

The main emphases of the research programmes were on reproductive physiology of cultivable marine fishes and shellfishes including cryopreservation of gametes, their development, evaluation and farm trials of compounded feed for prawns, disease investigation and control methods in culture systems and identification of genetic stocks in Indian mackerel.

PHYSIOLOGY

Studies on cryopreservation and its influence on storage and viability of gametes in mullet (PNP/38)

The main objective of the project was to preserve the motility of the sperms of the mullet, *Liza parsia* by devising certain methods, particularly by using some preservative media under low temperature. The motility of the sperms at normal room temperature (28°C ±2) in seawater was observed in the laboratory. Up and down or zigzag movements with greater speed lasted only for 3 to 5 mts. After that the speed reduced and the sperms entered into a passive condition within 10 mts. To sustain and preserve the motility of sperms for shorter and longer duration, various cryoprotectants with different temperature combinations were used and tested. Earlier experiments carried out at -180°C showed that speedy motility of the sperms could not be preserved successfully at this temperature in DMSO and other buffers. Further experiments were carried out at temperatures of -35°C and -10°C using 5 and 10% DMSO in combination with different buffers. The results showed that even -35°C was not a very favourable temperature for preservation of sperms for short duration. However, the sperm motility with speedy movements (50-60%) could be preserved upto 30-36 hrs in 10% DMSO combined with buffer 'b' at a temperature of -10°C. In buffers 'a' and 'd' (40%), motility of the sperms could be maintained for more than 24 hrs at this temperature. The sperms maintained in seawater and without use of any cryoprotectants could show motility only for a short while at this temperature. This indicated that - 10°C is most favourable temperature for sustaining the motility of sperms and 10% DMSO can be used as a good protective medium. The sperm counting was also done and the average sperms count determined for five fishes was around 9.0×10^9/fish.

Endocrinological factors influencing maturation in selected species of finfishes and prawns (PNP/39)

While correlating staining responses to several proteins in the eyestalk neurosecretory cells (NSC) of *P. stylifera* it was found that there was strong staining response in immature prawns while response was weak in matured females. However, staining response of NSC cells in brain and thoracic ganglion was reverse to that of eyestalk during the same stages of maturity.

To characterize neurosecretory material chemically, thin layer chromatography technique was used for the tissue extract of

eyestalk, brain and thoracic ganglion of prawn at different maturity stages. In all the samples only dopamine could be identified in varied concentrations depending upon the intensity of the colour formed. The intensity of colour was more in the samples of mature female prawns than the immature ones.

For determination of hormone characteristic in relation to maturation process, the technique for determination of molecular weight using standard protein markers was standardised through polyacrylamide gel electrophoresis.

Inducement of gonadal development and maturation in milkfish *Chanos chanos* (PNP/42)

Two size groups (above & below 1.5 kg) of milk fishes segregated and stocked in two ponds separately at the fish farm at Mandapam were monitored continuously. Fishes were fed regularly with supplementary feed at the rate of 10% of the body weight. Gonadal development of the fish was studied once in two months by biopsy method. Examination of ovary content revealed that the fishes were still in the immature stage. Efforts were made to acclimatize and maintain the fishes in healthy condition in the laboratory for hormone administration to enhance maturation.

NUTRITION

Farm trials of compounded feeds developed for selected species of prawns (PNP/35)

Prawn culture at certain farms along the coastal areas of Nellore was monitored and data on growth, production, feed conversion rate and other environmental parameters like salinity, temperature, pH and dissolved oxygen levels in water and organic carbon in soil were collected. *P. monodon* and *P. indicus* were the two species cultured with postlarvae collected from the wild as well as from hatcheries. While the former was cultured at relatively low salinity (10 to 20 ppt) the latter was cultured in salinities ranging from 15 to 35 ppt. Monoculture was practiced at most of the farms but mixed culture was also attempted in some ponds. Stocking densities ranged from 50,000 to 1,00,000 for *P. monodon* and 75,000 to 3,00,000 for *P. indicus*.

Feeds prepared in the farmsteads from locally available feedstuffs, without any technical advice, were screened for their proximate principles. Of the ten samples analysed, moisture varied from 6 to 10.2%, crude protein 30.08 to 42.1%, crude fat 3.25 to 7.05%, crude fibre 1.1 to 4.1%, ash 1.8 to 4.03%, carbohydrates 38.65 to 54.05% and calcium 0.06 to 4.2%.

With the aforementioned feeds and limited water exchange, a production of 1 to 1.5 t /ha/crop for *P. monodon* and 1.5 to 2.4 t/ha/crop for *P. indicus* was obtained by the farmers in a period of 4-5 months. A production of 3 t/ha/crop for *P. indicus* and 2.5 t/ha/crop for *P. monodon* was achieved using the same feeds with paddle-wheel aeration and water exchange in some ponds but a high feed conversion ratio (FCR) ranging from 3.2 to 4.8 was the major drawback. Nutrient imbalance, improper processing, inadequate binding and unscientific feeding practices can be attributed to the poor feed conversion ratio. Farmers were enlightened on these aspects of scientific aquaculture so as to increase productivity in subsequent crops. Technical advice was also rendered to the farmers with reference to water quality management, control of algal blooms and swarms of mysids, caridean prawns and hydromedusae and prevention of black gill disease which were also some of the factors contributing to low production.

Farm trials of a low cost feed, prepared with indigenous ingredients, was initiated during February 1991 and six ponds (four of 1 ha and two of 0.5 ha) were selected in a farm adopting semi-extensive (improved extensive) culture practices with limited water exchange facility, but without aerators. *P. indicus* seeds collected from the wild (15 to 25 mm) were stocked in the ponds at the rate of 1,00,000 per ha. Guidelines for feeding *viz.* time of feeding, feeding frequency, feeding rate, etc. were given to the farmer and the farm is being monitored by the project team. Environmental parameters monitored during the months of February and March indicated wide diel variations in dissolved oxygen, ammonia, pH and temperature in the ponds. Maximum and minimum atmospheric and surface water temperatures occurred at 1200 and 0400 hrs respectively; the difference in temperature within a day being 4°C for water and 5.3° C for atmosphere. Maximum pH was recorded at 1600 hrs and minimum at 0800 hrs. Dissolved oxygen levels varied from 0.96 to 9.29 ml/l (maximum at 1600 hrs and minimum at 0400 hrs) , the maximum daily difference being 5.86 ml/l. The level of ammonia in the ponds varied from trace to 1.4 mg at. N/l, the maximum being recorded at 0400 hrs and and the minimum at 2400 hrs. Phosphate level in water determined once every fortnight varied from trace to 2.523 mg/l. Plankton collections made at dawn and dusk (0600 and 1800 hrs) showed a predominance of diatoms such as *Biddulphia, Gyrosigma, Pleurosigma, Chaetoceros, Nitzschia, Navicula* and blue-green algae like *Oscillatoria* and *Phormidium*. Rotifers, mysids, copepods, copepod nauplii and fish larvae were the dominant zooplankters. Bioluminescence observed in two ponds was attributed to the presence of luminous bacteria. Growth patterns of the experimental animals and biomass variations in the ponds are being monitored.

PATHOLOGY

Disease investigation and disease control in culture system (PNP/37)

Data regarding prevalence of disease were collected from edible oyster and pearl oyster hatcheries of the Institute at Tuticorin, hatcheries of MPEDA, State fishery farms and various private agencies involved in culture activities.

An outbreak of soft prawn disease was reported in *P. indicus* and *P. monodon*. Bacteriological studies from these samples revealed presence of gram negative beacteria culturally indistinguishable from *Aeromonas hydrophila*. Histological changes involved extensive lytic necrosis and accumulation of oedematous fluid in interstitial spaces. Brown spot and black gill disease were recognised in *P. monodon*. The prawn showed ulceration in chitinous exoskeleton. Histological changes were confined to chitinous exoskeleton only. Incorporation of tetracycline in feed at the rate of 11 g per 50 kg of feed daily for 15 days and improving the hygiene resulted in complete curing of the disease. *Vibrio alginolyticus* infection was also recognised in *P. monodon* at one farm. The gills showed blackish discolouration. Improving water exchange and incorporation of oxytetracycline in feed could completely cure the disease.

Other pathological conditions recognised were protozoan infection in *P. monodon, P. indicus* and *M. monoceros*. It caused extensive necrosis of hepatopancreas and muscular tissue. Accumulation of albuminous fluid was noticed in between shell and body musculature. In hepatopancreas and body musculature oval type cells were recognised.

GENETICS

Identification of genetic stocks in Indian mackerel (*Rastrelliger kanagurta*) (PNP/41)

Zymogram patterns of five enzyme systems (LDH, IDH, EST, G6-PD, ADH) in mackerel (*Rastrelliger kanagurta*) populations were detected by disc gel electrophoresis. Though LDH and IDH patterns were similar in all populations tested, EST, G6-PD and ADH exhibited intraspecies polymorphism. Gene frequency values for first esterase locus alone differed between Cochin and Calicut populations.

FISHERY ECONOMICS AND EXTENSION DIVISION

Investigations on adoption potentials of fisheries innovations in marine sector (FE & E/ 23)

Under the village adoption project, the fishermen colony in Narakkal Panchayat was adopted for transfer of fish/prawn culture technology. In the first phase, farm families having owned /leased water areas (including canals of coconut groves) ranging from 25 cents to 100 cents were selected for transfer of prawn culture technology. Seeds of *P. indicus* were stocked during February-March and were harvested during April-May. Some of the farms experienced low oxygen conditions resulting in mortality of stocked prawns. However, in other farms a growth rate ranging from 86-145 mm in length yielding about 200 kgs of *P. indicus* and earning an income of about Rs. 14,400/- in the first phase against physical inputs costing about Rs. 13,400/- for the Institute.

TALKS

Dr. K. A. Narasimham, Principal Sceintist gave a talk on 'Mariculture and Environment' in connection with the World Environment Day celebration held at the Heavy water Science Club, Heavy Water Project, Tuticorin.

Dr. M. Peer Mohamed, Principal Scientist delivered a talk on 'Chemicals and drugs from Marine Organisms' at the Seminar on 'Problems and Prospects of Chemical and Marine based Industries'.

Dr. R. S. Lal Mohan, Principal Scientist delivered lectures on cetology at Annamalai University.

Dr. N. G. K. Pillai, Scientist (S.G.) gave a special talk on 'Development at the cost of Investment' at Kerala Institute of Local Administration, Trichur.

T. V. Programme

Dr. R. S. Lal Mohan, Principal Scientist gave a Doordarshan Programme in Trivandrum, Kerala on 'Dolphins of India', 16 February 1991.

Exhibitions

The Regional Centre of CMFRI, Mandapam Camp participated in the Exhibition in connection with the All India Conference on Technical Education and Industrial Development of Backward Areas held at Mohamed Sathak Polytechnic, Keelakarai, 27 November - 4 December 1990.

The Minicoy Research Centre of CMFRI participated in the Science and Arts Fair in connection with the Annual Day celebrations of Minicoy Govt. High School, 6 - 8 January '91.

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LIBRARY AND DOCUMENTATION SECTION

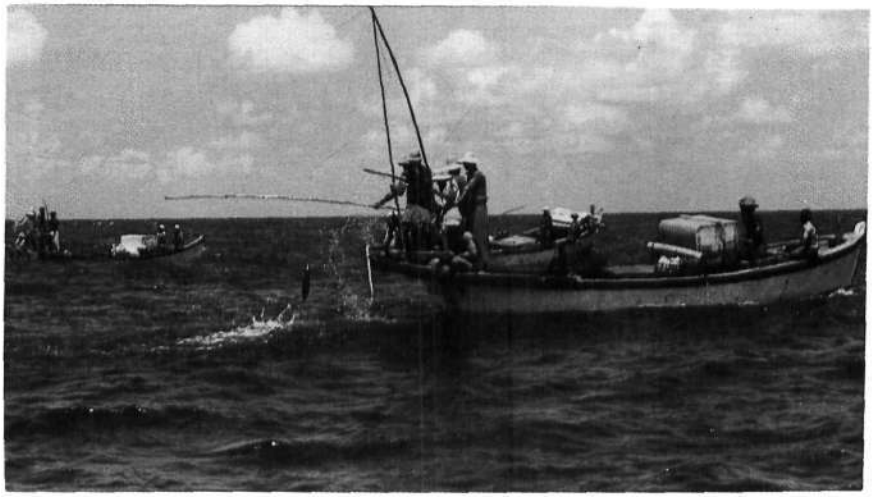
During the year, 26 books and 2,296 issues of periodicals were added to the library at the Headquarters. Essential books and periodicals were also acquired for the libraries at the Mandapam Regional Centre and at all the Research Centres. Interlibrary collaboration and interlibrary loan of books and periodicals were continued. Reference facilities were provided to visiting scientists, scholars and students of various Universities, Institutions, etc., from within and outside the country.

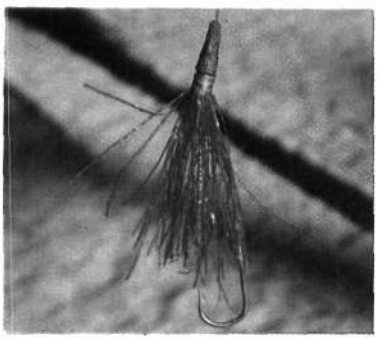
The mimeographed publications viz. 'Current Awareness Service' (monthly) and 'SD' Service (occasional) were continued to be issued. The library also stocks, distributes and sells the Institute's publications.

The following publications were issued.

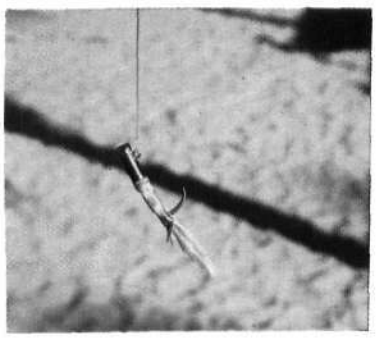
1.	Indian Journal of Fisheries	:	Vol. 36 (Nos. 2, 3 & 4) Vol. 37 (Nos. 1, 2, 3 & 4)
2.	Bulletin	:	No. 44 (Part III)
3.	Special Publication	:	No. 48
4.	Newsletter	:	Nos. 45-48
5.	Marine Fisheries Information Service	:	Nos. 99-106
6.	Research Highlights	:	1989-'90
7.	Brochures on the "Activities and Achievements" of the Research Centres at the following places : i) Veraval ii) Mangalore iii) Karwar iv) Kakinada		
8.	Annual Report	:	1989-'90
9.	Proceedings of the First Workshop on Scientific Results of FORV *Sagar Sampada*, 5-7 June 1989, Cochin.		

POLE AND LINE FISHING





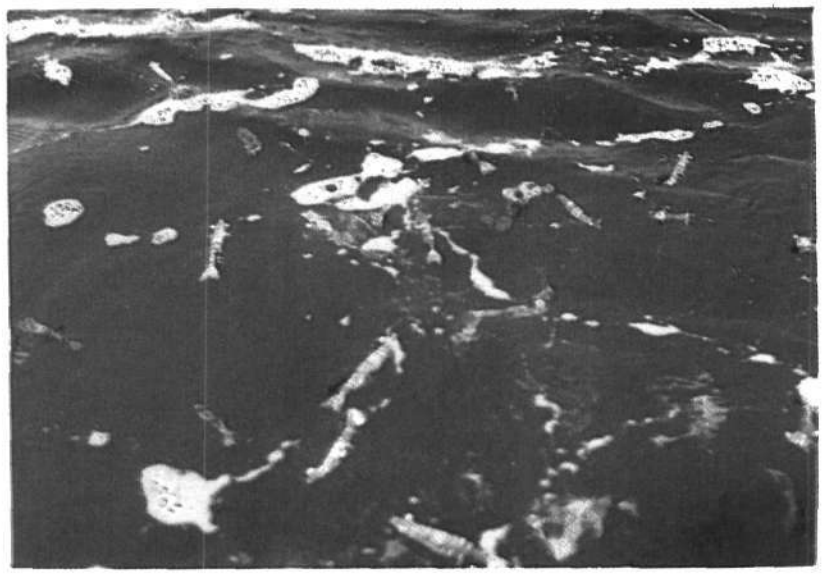
Artificial baits both the indigenous (left) and imported (right) types were used extensively this year in the pole and line fishery at Lakshadweep.



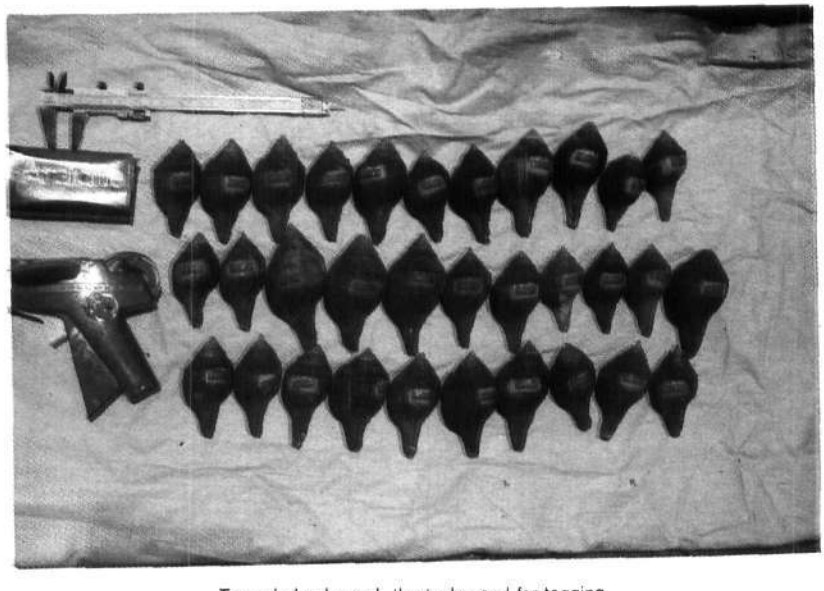
ARTIFICIAL REEF

Artificial reef made using old tyres being transferred to the installation site at Lakshadweep.

TAGGING



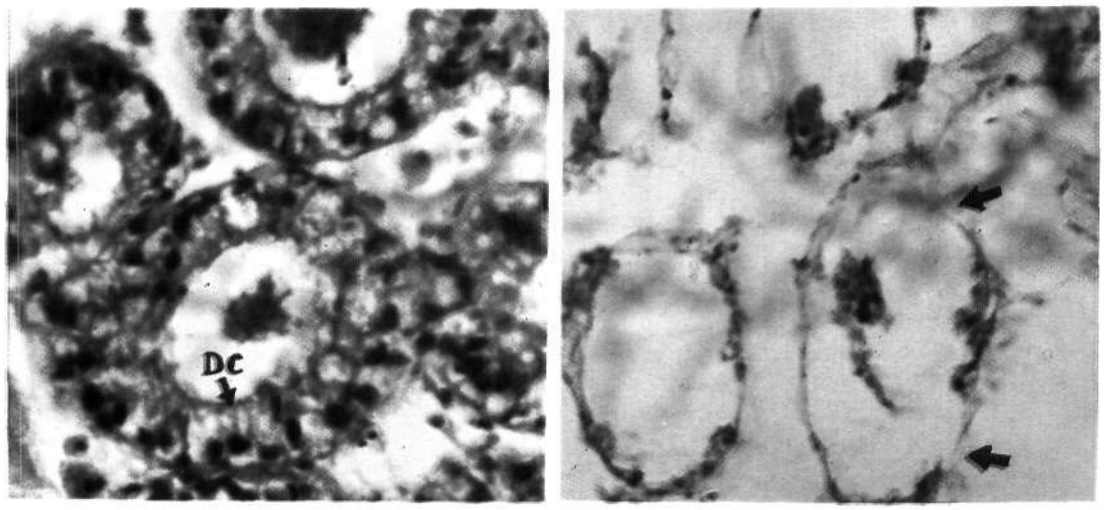
Tagged Prawns *Penaeus semisulcatus*
immediately after release, swimming in the sea.



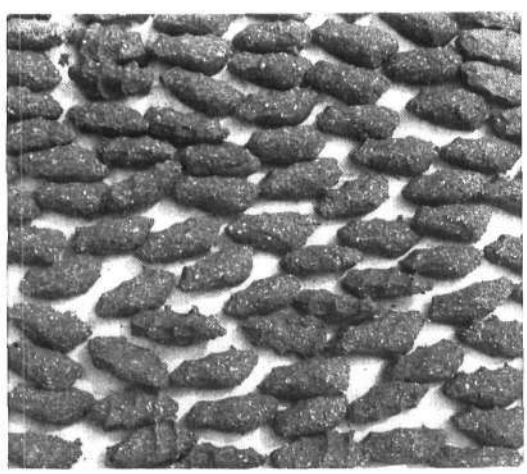
Tagged chanks and the tools used for tagging

POLLUTION

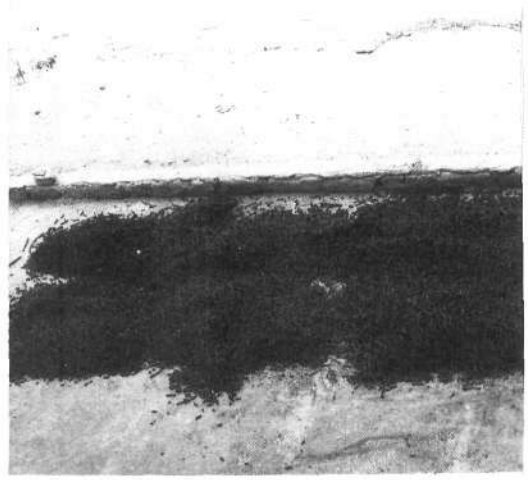
Digestive tubules and digestive cells (DC) in the control *Perna viridis* (left) and degeneration of digestive tubules after 2 week exposure to mercury (right). Arrows points to tubule breakdown.



NUTRITION



Semi-moist sun-dried feeds prepared and used by prawn farmers in Nellore district of Andhra Pradesh



Spaghetti like pelleted feeds prepared by prawn farmers as suggested by Nutrition scientists of the Institute. The feed developed has good hydro-stability exceeding 6 hours with the FCR about 1.5 under extensive farming conditions

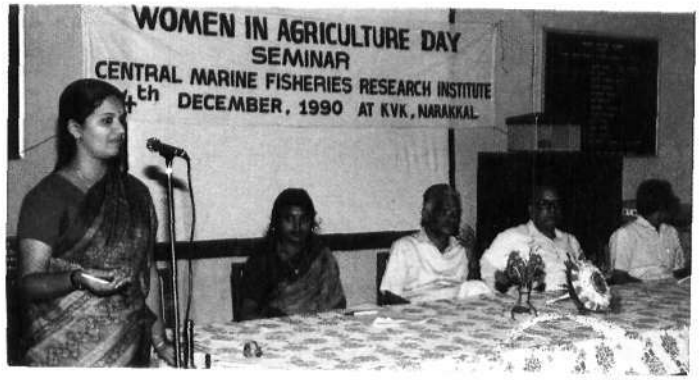
EXTENSION ACTIVITIES

Village adoption

Sluice gate being erected in the farmer's pond at Narakkal. The fishermen colony in Narakkal Panchayat was adopted by the Institute for transfer of fish/prawn culture technology.

Seminar

Ms. Hanza George, Agricultural Officer Mulavukad presenting her paper during the Seminar held in connection with "Women in Agriculture Day" at Narakkal.
Seated from left to right are Ms. Jancy Gupta, Scientist, CMFRI, Dr. C.T. Samuel, Retd. Professor & Head, Industrial Fisheries, CUSAT, Dr. P.S.B.R. James, Director, CMFRI and Dr. M.M. Thomas Officer-in-charge, KVK/TTC, Narakkal.



VISITORS

Team of Russian delegates visiting the Headquarters Museum.

POST-GRADUATE EDUCATION AND RESEARCH PROGRAMME IN MARICULTURE

Ph.D. Programme:

Six Senior Research Fellows were awarded Ph.D. degrees by the Cochin University of Science and Technology for their work on:

1. Role of trace elements on the growth and physiology of selected microalgae ..... S. Srisudha.

2. Studies on the digestive enzymes of the Indian white prawn, *Penaeus indicus* H. Milne Edwards ..... M. Hemambika.

3. Studies on the reproduction of Indian whiting, *Sillago sihama* (Forskal) (Percoidei, Sillaginidae) ... P. Jayashankar.

4. Studies on the digestive enzymes of the cultivable grey mullet, *Liza parsia* (Hamilton and Buchanan, 1822) ... K. Palaniswamy.

5. Studies on the ecology and production of algae in prawn and fish culture systems ..... R. Devapiriyan.

6. Studies on the pathobiology of penaeid larvae and post larvae .... A. Sait Shahul Hameed.

Five more Senior Research Fellows have submitted their theses to the Cochin University of Science and Technology. Twenty four Senior Research Fellows are actively pursuing their research work.

M.Sc. Programme:

Ten Junior Research Fellows of the 9th batch appeared for the M.Sc. Degree Final Semester Examination. The results are awaited. The Junior Research Fellows of the 10th and 11th batches are progressing well. The Mariculture Degree holders are in great demand and are booked by private firms even while they are doing the course. It is also gratifying to note here that out of the 16 candidates selected for the Agricultural Research Service, 8 are from the Mariculture course of the Post-graduate Education and Research Programme of the Institute.

KRISHI VIGYAN KENDRA

Courses conducted under K. V. K., Narakkal

Sl. No.	Subject	Short term training (below one month)			Long term training (above one month)			Total	
		No. of courses	No. of Trainees Males	Females	No. of courses	No. of Trainees Males	Females	Courses	Partici-pants
1.	Crop pro-duction	1	—	17	—	—	—	1	17
2.	Live stock production	13	36	256	—	—	—	13	292
3.	Fisheries	19	82	252	4	86	8	23	428
4.	Home Science	16	—	276	1	—	8	17	284
	Total	44	118	801	5	86	16	54	1021

The type of trainers trained were, practicing farmers (94), youths (110) and farm women (817).

Demonstration of various aspects of farming and other allied aspects were also taken up by the Kendra. The different aspects concerned were as follows:

Sl. No.		Item of Demonstration	No.	Area	No. of participants
i)		Pulses	1	KVK site	17
ii)		Fisheries			
	a)	Prawn seed collection	3	Surf region & canals of Nara-kkal &Chellanam	58
	b)	Eradication of predators from prawn culture farm	2	0.2 ha	21
	c)	Prawn farming	11	1.3 ha	11
	d)	Fish processing, preparation of pickles, wafers & cutlets	4	N.A.	71
iii)		Home Science			
	a)	Fruit preservation	5	N. A.	85
	b)	Garment making & Handicraft	4	N. A.	49
		Total	30	—	312

In addition to the regular training programme, the Kendra provided training on prawn and fish farming to 94 farmers sponsored by the Brackishwater Fish Farmers Development Agency.

Technical help in selective prawn farming was also rendered to some farmers. The officials from the Nationalised and Scheduled Banks were given training on important aspects of farming including the cost-benefit factor to enable them to evaluate the projects submitted by farmers for financial assistance. The training programmes have had a positive impact and a notable change in the adoption of technologies has been noticed. A number of trained farmers of the neighbouring Districts of Alleppey, Kottayam and Trichur are currently engaged in scientific farming of prawns and fishes. The farming activities has generated more employment opportunities and greater participation of trainees. Well organised teams of ex-trainees are also engaged in prawn seed trade. A team of eight ex-trainees, operating at Chettuva has been able to supply 17 lakhs of white prawn seed at the rate of Rs. 30/- per thousand during the month of January '91 alone and 40% of the total receipts is the net profit to the farmers. The cost benefit factor of scientific farming of white and tiger prawns are well appreciated by entrepreneurs. The KVK has been advocating the feasibility of taking three harvests of prawns in an year by judicious management and optimum utilisation of the monsoon months for enhanced production. This proposition has been put to reality, when an ex-trainee with the technical backing of the KVK, harvested 3,472.6 kg of prawns (3,045 kg of tiger prawns and 427.6 kg of white prawns) and 852 kg of quality fishes (429 kg of grey mullets and 423 kg of milk fishes) from a water area of 1.6 ha, in 3 culture operations lasting from May '90 to March '91 . The net income generated through these harvests was Rs. 4.50 lakhs against a total expenditure of Rs. 1.20 lakhs.

Training achievements of the Trainers' Training Centre

Sl.	Name of the Subject	Duration (days)	No. of training conducted	No. of persons trained
1.	SCUBA diving	45	1	6
2.	Prawn farming	10	1	9
3.	Hatchery production of prawn seeds	15	1	10
4.	Post harvest technology in fisheries	10	1	5
5.	Sea weed culture and utilisation	10	1	6
	Total		5	36

Trainees included the State Government and Union Territory officials (24), staff members of Universities (2), Research Institutes (3), other organisations and individuals (7).

The extension activities taken up by the KVK/TTC were as follows:

Sl. No.	Subject	No.	No. of participants
1.	Film shows	27	3500
2.	Radio talk	4	—
3.	Prawn harvest	2	700
4.	Prawn seed conditioning	2	150

Centre-wise list of Scientists and the Code Numbers of Projects in which the Scientist is Project Leader or Associate

Centre/ Name of the Scientist	Designation	Project Codes
COCHIN		
Dr. P. S. B. R. James	Director	
Shri K. V. Narayana Rao	PS	PF/IP/3, CF/IP/1
Dr. K. Alagaraja	PS	FSS/FRA/1.3, FSS/FRA/ST.1, FSS/FRA/1.18, DF/IP/1
Shri M. S. Rajagopalan	PS	FEM/ES/1, FEM/ES/5, FEM/RS/1
Dr. A. Noble	PS	PF/IP/1, PF/IP/3, PF/IP/6, CF/IP/1
Shri D. Sadananda Rao	PS	FEM/ES/5
Shri G. Subbaraju	PS	FEM/RS/1
Dr. P. Bensam	PS	DF/IP/4, FORV/SS/3
Dr. C. S. Gopinadha Pillai	PS	FEM/EE/1
Dr. A. D. Diwan	S(S-3)	PNP/38, PNP/42
Shri D. B. S. Sehara	S(SG)	FE&E/23
Dr. C. Suseelan	S(SG)	PF/IP/6, DF/IP/1, DF/IP/4
Shri V. Kunjukrishna Pillai	S(SG)	FEM/MP/1
Dr. K. J. Mathew	S(SG)	FORV/SS/3
Dr. K. Rengarajan	S(SG)	FORV/SS/3
Dr. (Ms.) S. Sivakami	S(SG)	PF/IP/1, PF/IP/3, DF/IP/1, DF/IP/4
Shri G. S. Daniel Selvaraj	S(SG)	FEM/ES/1, FEM/ES/5
Shri K. Narayana Kurup	S(SG)	FSS/FRA/1.1, FSS/FRA/ST.1, FSS/FRA/1.18
Shri G. Nandakumar	S(SG)	DF/IP/1, CF/IP/1, CF/IP/2
Ms. Mary K. Manissery	S(SG)	On study leave
Shri N. Surendranatha Kurup	S(SG)	DF/IP/1, CF/IP/1
Dr. A. Regunathan	S(SG)	FE&E/23
Dr. N. Gopinatha Menon	S(SG)	PF/IP/1, PF/IP/5, PF/IP/6, DF/IP/1, DF/IP/4, FORV/SS/3
Shri K. Balan	S(SG)	FSS/FRA/ST.1, FSS/FRA/1.18
Dr. (Ms.) V. Chandrika	S(SG)	FEM/ES/1
Dr. K. S. Scariah	S(SG)	FSS/FRA/ST.1, FSS/FRA/1.18, FSS/FRA/1.19

Shri R. Sathiadhas	S(SG)	On study leave
Shri K. V. Somasekharan Nair	S(SG)	DF/IP/1, DF/IP/4, CF/IP/1
Shri K. K. P. Panikkar	S(SG)	PF/IP/3
Dr. N. Gopalakrishna Pillai	S(SG)	PF/IP/1, PF/IP/3, DF/IP/4
Shri K. N. Rajan	S(SG)	DF/IP/1, DF/IP/4, CF/IP/1
Shri M. Srinath	S(SG)	FSS/FRA/1.3, FSS/FRA/ST. 1, FSS/FRA/1.18
Shri P. C. Thomas	S(SG)	PNP/41
Dr. K. C. George	S(SG)	PNP/37
Dr. M. K. George	S(SG)	PNP/41
Shri R. N. Misra	S(SG)	FEM/ES/5, FEM/MP/1
Shri K. Prabhakaran Nair	S(SG)	PF/IP/6, DF/IP/4, CF/IP/2, FORV/SS/3
Shri P. E. Sampson Manickam	S(SG)	DF/IP/1, CF/IP/2
Shri K. R. Manmadhan Nair	S(SG)	DF/IP/1, DF/IP/4, CF/IP/2, FORV/SS/3
Ms. Krishna Srinath	S(SG)	On study leave
Shri S. Muthusamy	S(S-2)	FEM/ES/1
Ms. Grace Mathew	S(S-2)	PF/IP/1, DF/IP/1, DF/IP/4
Ms. T. S. Naomi	S	FEM/ES/1, FORV/SS/3
Ms. K. Vijayalakshmi	S	FSS/FRA/ST.1, FSS/FRA/1.18, FSS/FRA/1.19
Ms. Jancy Gupta	S	FE&E/23
Dr. Mohan K. Zachariah	S	PNP/39
Dr. N. Sridhar	S	PNP/39
Ms. Puthran Prathibha	S	PF/IP/3, DF/IP/1, DF/IP/4, CF/IP/1
Ms. V. Kripa	S	DF/IP/1, MOL/RE/2
Dr. (Ms.) M. K. Sanhotra	S	PNP/35
Dr. A. K. Pandey	S	PNP/39
Dr. Naresh Kumar Varma	S	PNP/41
Dr. I. D. Gupta	S	PNP/41
Shri T. V. Sathianandan	S	FSS/FRA/ST.1
Shri P. Vijayagopal	S	PNP/35

MANDAPAM CAMP

Dr. R. Marichamy	PS	DF/CUL/3, DF/CUL/2
Shri N. Neelakanta Pillai	S(SG)	CF/CUL/1.1.7, FORV/SS/3
Dr. N. Kaliaperumal	S(SG)	FEM/SW/1

Shri A. A. Jayaprakash	S(SG)	PF/IP/1, DF/IP/1, CF/IP/1
Shri P. Livingston	S(SG)	PF/IP/1, DF/IP/1
Shri A. Raju	S(SG)	DF/CUL/3, PNP/42
Shri A. P. Lipton	S(SG)	PF/IP/5, DF/IP/1, MOL/RE/2, PNP/37
Dr. P. Nammalwar	S(SG)	DF/CUL/3
Dr. E. V. Radhakrishnan	S(SG)	CF/CUL/1.1.7
Shri S. Krishna Pillai	S(S-2)	FEM/ES/1
Dr. P. Jayashankar	S	PF/IP/1, DF/IP/1, DF/CUL/3
Ms. Reeta Jayashankar	S	FEM/ES/1, FEM/SW/1, FEM/CUL/1
Shri G. Maheshwarudu	S	DF/IP/1, CF/CUL/1.1.7, CF/IP/1
VERAVAL		
Dr. Alexander Kurian	S (SG)	PF/IP/1, PF/IP/2
Dr. E. Vivekanandan	S (SG)	PF/IP/1, DF/IP/1
Shri K. P. Said Koya	S	PF/IP/1, PF/IP/2
Shri K. K. Philipose	S	PF/IP/2, DF/IP/1
BOMBAY		
Dr. (Ms.) P. V. Kagwade	PS	DF/IP/1
Dr. Kuber Vidyasagar	S (SG)	DF/IP/1
Dr. S. K. Chakraborthy	S (SG)	PF/IP/2, DF/IP/1
Shri K. S. Sundaram	S (SG)	DF/IP/1
Shri M. Zaffar Khan	S (SG)	PF/IP/1, PF/IP/2, DF/IP/1
Dr. V. D. Deshmukh	S (SG)	PF/IP/2, DF/IP//1
Shri S. G. Raje	S (SG)	PF/IP/1, PF/IP/2, DF/IP/1
Shri M. Aravindakshan	S	PF/IP/2, DF/IP/1
Dr. V .V. Singh	S	FEM/ES/1
KARWAR		
Shri G. G. Annigeri	P S	PF/IP/3, CF/IP/1
Dr.V. S .Kakati	S (SG)	DF/IP/1,CF /IP/1, FORV/SS/3
Shri V. Gandhi	S (SG)	PF/IP/3, DF /IP/1
Dr. P. K. Krishna Kumar	S	FEM/ES/1, FEM/MP/1
Shri P. K. Asokan	S	DF/IP/1, CF/IP/1, MOL/RE/2, MOL/CUL/7
MANGALORE		
Dr. P. V. Rao	P S	FORV/SS/3
Dr. P. P .Pillai	S (S-3)	PF/IP/1, PF/IP/3, DF/IP/1, FORV/SS/3

Shri K. K. Sukumaran	S (SG)	PF/IP/5, DF/IP/1, CF/IP/1
Shri G . M. Kulkarni	S	PF/IP/1, PF/IP/3, DF/IP/1
Shri P.U. Zachariah	S	PF/IP/1, PF/IP/3, DF/IP/1
Dr. Sunil Kumar Mohamed	S	PF/IP/1, DF/IP/1, MOL/RE/2
Ms .M. P. Molly	S	FEM/ ES/1, FEM/ES/5
CALICUT		
Dr. V. Narayana Pillai	PS	FEM/ES/1, FORV/SS/1
Shri M. Kumaran	PS	DF/IP/1, CF/IP/1
Dr. R. S. Lal Mohan	PS	PF/IP/1, DF/IP/1
Dr. P. S. Kuriakose	S (S-3)	MOL/CUL/4
Shri G. P. Kumaraswamy Achary	S (SG)	DF/IP/1, MOL/CUL/4, FORV/ SS/3
Shri M. Sivadas	S	PF/IP/1, PF/IP/5, DF/IP/1, CF/IP/1
Shri C. V. Mathew	S	FEM/ES/1, FEM/ES/5
Shri M. Feroz Khan	S	PF/IP/1, DF/IP/1, CF/IP/1
Ms. P. T. Sarada	S	DF/IP/1, CF/IP/1
VIZHINJAM		
Dr. P. A. Thomas	S (SG)	FEM/ES/1
Shri K. K. Appukuttan	S (SG)	On Study leave
Dr. S. Lazarus	S (SG)	PF/IP/1, DF/IP/5
Ms. Rani Mary George	S (SG)	FEM/ES/1
Shri G. Gopakumar	S (SG)	PF/IP/1, PF/IP/5, CF/IP/1, FEM/EE/1
Dr. N. Ramachandran	S(S-2)	CF/IP/1, MOL/RE/2
Ms. S. Jasmine	S	FEM/ES/1, FEM/EE/1
TUTICORIN		
Dr. K .A. Narasimham	PS	MOL/CUL/4
Dr. M. Peer Mohamed	PS	FEM/MP/1
Dr. A. C. C. Victor	S(SG)	MOL/CUL/4, MOL/CUL/6
Shri A. Chellam	S(SG)	MOL/CUL/4, MOL/CUL/6, FEM/CUL/1
Shri S. Dharmaraj	S (SG)	MOL/CUL/4, MOL/CUL/6
Shri M. E. Rajapandian	S (SG)	MOL/CUL/4, MOL/CUL/7
Shri P. Muthiah	S (SG)	MOL/CUL/4, MOL/CUL/7, FEM/CUL/1
Shri K. Ramadoss	S (SG)	PF/IP/5, MOL/RE/2, MOL/ CUL/4
Shri P. Sam Bennet	S (SG)	DF/IP/1, CF/IP/1

Shri K. M. S. Ameer Hamsa	S (SG)	PF/IP/1,/ DF/IP/1
Dr. H. Mohamed Kasim	S (SG)	PF/IP/1, DF/IP/1
Dr. D. B. James	S (SG)	FEM/CUL/2
Dr. M. Rajamani	S (SG)	DF/IP/1, DF/IP/5, CF/IP/1
Dr. C. P. Gopinathan	S (SG)	MOL/CUL/4, FEM/ES/1, FEM/MP/1, FEM/CUL/1
Dr. D. C. V. Easterson	S (SG)	On study leave
Shri D. Kandasamy	S(SG)	FEM/MP/1,PNP/35
Shri T. S. Velayudhan	S (SG)	MOL/CUL/4, MOL/CUL/6
Shri D. Sivalingam	S (S-2)	DF/IP/1, MOL/CUL/4
Shri V. S. Rengasamy	S (S-2)	PF/IP/1, DF/ IP/1
Ms. Rani Palanisamy	S	MOL/CUL/4, MOL/CUL/7
MADRAS		
Dr. K. Satyanarayana Rao	PS	MOL/CUL/7
Shri N. S. Radhakrishnan	S (SG)	DF/IP/1, CF/ IP/1
Shri R. Thiagarajan	S (SG)	PF/IP/1, DF/IP/1
Dr. P. Devadoss	S (SG)	PF/IP/1, PF/IP/5, DF/IP/1, CF/IP/1
Shri J. C. Gnanamuttu	S (SG)	DF/IP/1, CF/IP/1
Shri G. Mohanraj	S (SG)	PF/IP/1, DF/IP/ 1, CF/IP/1
Shri R. Sarvesan	S (SG)	On Study leave
Dr. P. V. Sreenivasan	S (SG)	MOL/RE/2, MOL/CUL/7
Shri M. Vijayakumaran	S (SG)	PNP/35
Shri K. G. Girijavallabhan	S (SG)	FEM/ES/1
Shri M. Rajagopalan	S (SG)	FEM/ES/1, FEM/ES/5
Dr. R. Paul Raj	S (SG)	PNP/35,PNP/42
Shri M. M. Meiyappan	S (SG)	DF/IP/1, CF/IP/1, FORV/SS/3
Shri S. Srinivasarengan	S (S-2)	DF/IP/1, CF/IP/1
Shri V. Thangaraj Subramanian	S (S-2)	DF/IP/1, CF/IP/1
Shri P. Natarajan	S (S-2)	CF/IP/1, MOL/RE/2, MOL/CUL/7
KAKINADA		
Dr. V. Sriramachandra Murty	S (SG)	DF/IP/1
Shri C. Muthiah	S (SG)	On study leave
Dr. G. Syda Rao	S (SG)	DF/IP/1, MOL/RE/2, MOL/CUL/7
Dr. (Ms.) Lalitha Devi	S (SG)	On study leave
Dr. P. N. Radhakrishnan Nair	S (SG)	DF/IP/1, CF/IP/1

VISAKHAPATNAM		
Dr. G. Luther	PS	PF/IP/1, CF/ IP/1
Dr. T. Appa Rao	PS	DF/IP/1
Shri S. Reuben	S (S-3)	PF/IP/5, DF/IP/1, CF/IP/1
Dr. G. Sudhakara Rao	S (SG)	DF/IP/1, CF/IP/1, CF/IP/2
Shri Y. Appanna Sastry	S (SG)	PF/IP/1, DF/IP/1
Shri G. Radhakrishnan	S	DF/IP/1
Shri K. Vijayakumaran	S	FEM/ES/1
MINICOY		
Dr. V. S. K. Chennubhotla	PS	FEM/SW/1
Shri T. M. Yohannan	S (SG)	PF/IP/4, DF/IP/5
Shri Pon Siraimeetan	S (SG)	DF/IP/5, FEM/ES/1
Dr. P. Kaladharan	S	PF/IP/4, FEM/ES/1, FEM/ SW/1
KVK/TTC, NARAKKAL		
Dr.M.M. Thomas	PS	Extension & Training, FE&E/23
Dr. D. Noble	S (SG)	Extension & Training

DEPUTATIONS

Dr. R. S. Lal Mohan, Principal Scientist to Netherlands to attend IUCN Working Group Workshop, 8-9 June '90.

Dr. P. S. B. R. James, Director and **Dr. P. Parameswaran Pillai**, Scientist (S-3) participated in the Expert Consultation of Stock Assessment of Tunas in the Indian Ocean held at Bangkok, 2-6 July '90.

Dr. R. S. Lal Mohan, Principal Scientist to La Jolla Saidiego, California, U. S. A. to attend IWC Conference on Mortality of Dolphin in Gillnets, 20-26 October '90.

Dr. M. M. Thomas, Chief Training Organiser and Officer-in-charge, KVK/TTC, Narakkal for participatory training under USAID/ICAR at Bangalore, 23 April - 4 May '90.

CONSULTANCY/ADVISORY

Dr. C. Suseelan and **Shri K. Narayana Kurup**, Scientists (S. G.) attended the Second, Third and Fourth meetings of the members of the Advisory Committee and Core Team constituted to study the impact of ban on monsoon trawling along Kerala coast held respectively at Cochin 4 April '90, at Trivandrum 30 April '90 and at Cochin 26 May '90.

Centre-wise list of Technical/Ministerial/Auxiliary/ Supporting Staff as on 31st March 1991

(Not a gradation list)

CMFRI — Headquarters, Cochin

Technical Staff

T-7

Shri S. Natarajan — *Field Officer*
Shri G. Balakrishnan — *Field Officer*
Shri P. R. Leopold — *Skipper*
Shri P. K. Velayudhan — *Mate*

T-6

Field Officers

Shri Varughese Philippose
Shri V. Rajendran

T-5

Technical officers

Shri K. Kanakasabapathy — *Library & Documentation*
Dr. E. Johnson — *Library &Documentation*
Shri P. Raghavan — *Photography*
Shri B. Ramesh — *Bosun*
Shri K. C. Yohannan
Shri M. Ayyappan Pillai
Shri V. K. Balachandran
Shri K. N. Gopalakrishnan
Shri P. Karunakaran Nair
Shri Varughese Jacob
Shri G. Krishnankutty Nair
Shri P. Sivaraman
Ms . K. S. Leela Bhai
Ms. V. P. Annam

T-4

Sr. Technical Assistants

Shri P. M. Aboobaker
Shri R. Reghu
Shri A. A.Thankappan
Ms. Geetha Antony
Ms. C. Nalini
Shri N. P. Kunhikrishnan
Shri V. Suresh
Shri K. Thulasidas
Shri K. L. K. Kesavan — *Sr. Artist*

T. II. 3

Technical Assistants

Shri Joseph Andrews
Ms. A. Kanagam
Shri A. Kanakkan
Shri S. Haja Najeemuddin
Shri C. J. Prasad
Shri A. Nandakumar
Ms. P. L. Ammini
Shri K. Balachandran

T. I. 3

Shri V. A. Narayanan Kutty
Shri K. Ramadoss Gandhi
Shri K. Chellappan
Ms. K. K. Valsala
Shri Mathew Joseph
Shri M. N. Kesavan Elayathu
Shri J. Narayanaswamy
Ms. S. Girija Kumari — *Lib. Asst.*
Shri C. D. Davis — *Motor Driver*
Shri T. R. Sreekumaran — *Oilman*

T-2

Junior Technical Assistants

Shri M. P. Sivadasan
Shri L. R. Khambadkar
Shri M. Abdul Nizar

Punch Card Operators

Shri K. P. George

Shri M. B. Seynudeen
Shri P. P. Pavithran
Ms. M. R. Beena
Ms. P. T. Mani
Shri M. Ramachandran
Shri K. Anandan
Ms. Latha Khambadkar

Jr. Library Assistants

Ms. P. Geetha
Ms. K. Ramani
Shri V. Mohan
Shri K. K. Sankaran — *Artist*
Shri K. Chacko — *Projector Operator*

Motor Drivers

Shri S. Yadavaiah
Shri K. J. Mathew
Shri M. N. Appukuttan Nair
Shri K. K. Soman
Shri K. P. Vijayan — *Sr. Deckhand*
Shri P. D. Chidambaram — *Oilman-cum-Deckhand*

T - 1

Field Assistants

Shri R. Anilkumar
Shri P. K. Baby
Ms. K. P. Salini
Shri K. M. Venugopalan
Shri K. Soloman
Shri K. G. Baby
Shri K. N. Pushkaran
Shri V. R. Arunachalam
Shri Thomas Kuruvilla
Shri K. C. Pradeep Kumar
Ms. P. K. Seetha
Shri V. K. Suresh
Shri A. Udayakumar
Ms. T. N. Anandalakshmy
Shri C. Unnikrishnan
Shri G. Subbaraman — *Punch Card Operator*
Ms. P. M. Geetha — *Museum Assistant*

Ministerial Staff

Shri P. James Abraham — *Sr. Adm. Officer*
Shri E. Athmanathan — *Adm. Officer*
Shri M. P. Lakshmanan — *Asst. Adm. Offcer*
Shri T. V. Asari — *Sr. Finance & Acc. Officer*
Shri K. U. K. Menon — *Asst. Finance & Acc. Officer*
Ms. P. J. Sheela — *Hindi Officer*

Superintendents

Shri S. Subramanian
Shri R. Kuppuswamy
Shri V. Chemutty
Shri M. Selvadhas
Shri J. M. Vaz
Shri P. J. Davis

Assistants

Shri M. Ramakrishnan
Shri M. J. John
Shri A. Narayanaswamy
Shri P. Ganeshan
Shri S. Abdulla
Shri K. L. K. Padmanabhan
Ms. T. K. Ponnamma
Shri M. Ganapathy
Ms. P. V. Mary
Shri K. Arumugham
Shri M. Velu
Ms. M. A. Seetha — *Senior Stenographer*

Stenographers

Shri K. M. Surendran
Ms. D. Geetha
Shri C. Yohannan
Ms. A. K. Omana

Jr. Stenographers

Ms. N. Ambika
Ms. N. R. Latha Devi
Ms. K. V. Sajitha
Shri R. Chandrakesa Shenoy
Ms. K. J. Malathi Devi
Ms. N. Yesodha
Shri C. G. Thomas
Shri C. N. Chandrasekharan
Ms. Christina Joseph
Ms. V. K. Sobha

Sr. Clerks

Ms. T. Madhavi
Shri V. V. Lakshminarayanan
Shri V. P. Unnikrishnan
Ms. P. K. Sridevi
Shri V. Chandrasekharan
Ms. A. Renjini
Ms. K. M. Annamma
Ms. M. O. Leela
Shri V. Mohanan
Ms. K. Vijayalekshmi
Ms. K. C. Karthiayini
Shri A. P. Balakrishnan
Ms. M. Suseela
Shri N. Govindan
Shri M. K. Abdulla
Shri T. N. Padmanabha Kurup
Ms. K. C. Girija
Ms. Alice Valooran
Ms. M. M. Teresakutty

Jr. Clerks

Ms. K. Santha
Shri Thomas Joy
Ms. N. K. Suseela
Ms. G. Ambika
Shri K. J. Mathew
Shri P. M. Bhaskaran
Ms. N. S. Sarala
Ms. P. S. Sumathy
Ms. M. G. Chandramathy
Shri C. K. Sivadas
Shri M. Samuthiram
Shri K. Baburajan
Shri V. C. Antony
Ms. I. M. Baby Rajalakshmi
Ms. V. Parukutty
Ms. A. K. Kunjipennu
Shri M. Balaraman
Shri K. Ramadasan
Ms. K. K. Kousallia
Shri Benny Mathew
Shri V. C. Subhash
Ms. V. Jayalakshmi
Shri K. Sadanandan
Ms. K. Balamani
Ms. N. G. Supriya
Ms. P. K. Mary
Ms. G. Ponnamma
Ms. N. M. Ponnamma
Shri M. J. Tomy Prince — *Telephone*

Auxiliary Staff

Ms. E. K. Uma — *Sr. Hindi Translator*
Ms. E. Sasikala — *Hindi Translator*

Drivers for Light Vehicles

Shri M. B. Xavier
Shri V. A. Surendran
Shri A. Rajan
Shri M. R. Bharathan — *Deckhand*
Shri Ravindran Andi — *Deckhand*
Shri M. Krishnan — *Binder*
Shri N. Ravindranathan Nair — *Sr. Gestetner Operator*

Supporting Staff

SSG-IV

Lab. Attendants

Shri P. A. Vasudevan
Shri K. P. Joseph
Shri P. A. Vasu — *Fieldman*
Shri M. K. Peethambaran — *Fieldman*
Shri T. A. John — *Khalasi*
Ms. N. Leela — *Daftry*

SSG-III

Shri K. S. Vaidyalingam — *Fieldman*
Shri M. L. Antony — *Lib. Attendant*
Shri A. P. Sebastian — *Peon*

SSG-II

Peons

Shri T. A. Vijayan
Shri N. T. Velappan

Watchmen

Shri B. Zainudheen
Shri E. F. Francis
Shri K. Ganesan
Shri C. Chandran

Shri G. Mithralal
Shri G. Vijayan
Shri P. K. Achuthan

Messengers

Ms. R. Devalakshmi
Shri T. Sreedharan
Shri A. Gopinathan
Shri K. C. Hezhakiel

Safaiwalas

Shri K. Velayudhan
Ms. K. K. Kalliani
Shri C. O. Viswambaran

SSG-I

Watchmen

Shri K. Velayudham
Shri K. T. Rajappan
Shri P. K. Suresh Babu
Shri E. J. James
Shri V. T. Ravi
Shri P. K. Ravindran
Shri P. K. Chellappan
Shri K. C. Rajappan

Messengers

Shri T. Vijayakumar
Shri M. P. Mohandas
Shri T. M. Abdul Aziz
Shri D. Prakasan
Shri R. Ravindranathan Nair
Shri V. A. Kuttappan
Shri T. I. Soman
Ms. Pennamma Joseph
Shri N. K. Harshan
Ms. R. M. Sarasamma
Shri V. Krishnan
Shri P. V. Gopalan
Shri. S. Mohanan — *Lift Operator*
Shri T. K. Antony — *Lift Operator*
Shri K. G. Radhakrishnan Nair — *Helper*
Shri V. H. Venu — *Binder*
Shri N. V. Thambi — *Lab. Attendant*
Shri S. Narayanan Achari — *Lab. Attendant*
Ms. J. Sudha Devi — *Cane weaver*

Fieldmen

Shri P. B. Jeevaraj
Shri P. S. Allocious
Shri P. V. Joy
Shri V. K. Aravindakshan

Safaiwalas

Shri P. D. Karunakaran
Ms. B. Savithri
Shri N. P. Mohanan
Shri V. C. Gopi
Shri K. N. Balan
Shri B. Babu
Ms. A. Lata
Shri N. K. Shanmughan

Gardeners

Shri T. Lawrence
Shri K. C. Jayaprasad

Chavakkad Field Centre

Shri C. K. Krishnan — *Sr. Tech. Asst.*

Quilon Field Centre

Shri Babu Philip —*Technical Officer*
Shri S. B. Chandrangathan — *Technical Officer*

Alleppey Field Centre

Shri A. Y. Jacob — *Field Assistant*

Mandapam Regional Centre

Technical Staff

T-7

Shri B. S. Ramachandrudu — *Farm Engineer*

T-5

Technical Officers

Shri S. Kalimuthu
Shri M. Badrudeen
Shri C. Kasinathan — *Curator*

T-4

Shri P. Thankappan — *Foreman*

T. II. 3

Technical Assistants

Dr. K. Muniyandi
Shri A. Ganapathy
Shri S. Palanichamy
Shri V. Edwin Joseph — *Lib. Asst.*
Shri T. K. Sudhakaran — *Bosun*

T. I. 3

Technical Assistants

Shri J. R. Ramalingam
Shri M. Najmuddin
Shri M. R. Arputharaj
Shri M. Bose
Shri A. Ramakrishnan
Shri A. Muniyandi — *Artist*
Shri Md. Jaffar — *Driver (Boat)*
Shri P. Muniasamy — *Deckhand*
Shri P. Krishnan — *Motor Driver*
Shri O. Muthukaruppan — *Motor Driver*
Shri R. Marimuthu — *Painter-cum-Polisher*
Shri S. Mohideen Meerasa — *Sr. Deckhand*

T-2

Jr. Technical Assistants

Shri P. Thillairajan
Shri R. Subramanian
Shri M. Ebrahim — *Sr. Deckhand*
Shri T. P. Haridasan — *Carpenter*
Shri M. Rengan — *Cook (Boat)*

T-1

Shri N. Ramamurthy — *Museum Asst.*
Shri R. Sekhar — *Deckhand*
Shri A. Gandhi — *Field Asst.*
Shri V. Sethuraman — *Field Asst.*
Shri Sanjay Kumar Dana — *Mechanic*

Ministerial Staff

Shri A. Sethubhaskaran — *Asst. Adm. Officer*
Shri V. M. Mariappan — *Assistant*
Shri A. Kajendran — *Assistant*

Senior Clerks

Shri K. Margathavadivelu
Shri S. Nagarajan
Shri V. Chandran
Shri. P. Selvaraj
Ms. N. Gomathy — *Jr. Stenographer*

Junior Clerks

Shri A. Yagappan
Shri N. Natarajan
Shri S. Muthumari
Ms. S. Parisa
Ms. M. Rameshwari

Supporting Staff

SSG-IV

Lab. Attendants

Shri S. Mohamed Yousuff
Shri K. Muthramalingam
Shri M. Chinnasamy
Shri A. Raman — *Fieldman*

SSG-III

Lab. Attendants

Shri S. Muthramalingam
Shri M. Ibrahimsa
Shri K. Gopalakrishnan
Shri A. Muniasamy

Fieldmen

Shri A. Subramanian
Shri S. Mani
Shri R. Nagan
Shri S. Pitchai — *Daftry*

Watchmen

Shri R. Sonai
Shri K. Muthiah
Shri M. Ramu
Shri P. Karuppiah

Safaiwalas

Shri R. Sevugan
Shri M. Muthu
Shri V. Sanathanan
Shri K. Kuruvan
Shri A. Mari
Shri R. Alagan

SSG-II

Shri M. Athimoolam — *Cook*

Watchmen

Shri K. Muniasamy
Shri M. Govindaraj
Shri G. Saivadurai
Shri K. Vellayan
Shri P. Ramu
Shri S. Arulsamy

Safaiwalas

Shri L. Sathan
Shri G. Ankaiah
Ms. J. Kondamma
Shri K. Gurusamy
Shri S. Nagammal
Shri R. Sonaimuthu
Shri K. Subramanian
Shri S. Arumugham
Shri S. Murugan
Shri A. Palanichamy — *Messenger*

SSG-I

Lab. Attendants

Shri S. Muruga Boopathy
Shri N. Ramakrishnan
Shri C. Ramadas
Shri E. Natarajan
Shri A. Yesudhas
Shri K. Jeekanantham
Shri M. Bareen Mohamed
Shri S. M. Seeni
Shri K. U. Raman — *Khalasi*

Fieldmen

Shri M. Kuberaganeshan
Shri K. Thangavel
Shri A. Vairamani
Shri N. Boominathan
Shri S. M. Sikkender Batcha
Shri T. Thangarajan — *Oilman*
Shri M. Sahul Hameed — *Messager*
Shri S. Kannadoss — *Messenger*
Shri J. Padmanathan — *Lascar*
Shri A. Susai — *Khansama*
Shri J. Hameed Sultan — *Pump Driver*
Shri G. K. Rajan — *Pump Driver*
Shri B. Ramesh — *Daftry*

Watchmen

Shri S. Balakrishnan
Shri V. Alagan
Shri N. Rajavelu

Safaiwalas

Shri V. Narasimmabharathi
Shri U. Rajendran
Shri S. Murugan

Nagapattinam Field Centre

Shri V. Sivasamy — *Tech. Asst.*
Shri V. Thanapathi — *Tech. Asst.*
Shri R. Somu — *Jr. Tech. Asst.*

Pattukottai Field Centre

Shri K. Muthiah — *Tech. Asst.*
Shri N. Vaithanathan — *Tech. Asst.*
Shri P. Palani — *Jr. Tech. Asst.*
Shri A. Kumar — *Jr. Tech. Asst.*

Veraval Research Centre

Technical Staff

T. I. 3

Shri Y. D. Savaria — *Tech. Asst.*

T-2

Jr. Technical Assistants

Shri H. K. Dhokia
Shri B. P. Thumber

T-1

Field Assistants

Shri Ladani Amruthalal Arjanbhai
Shri B. A. Ponchabhai
Shri P. J. Premji
Shri M. S. Zala
Shri J. D. Vanvi
Shri G. N. Chudasama — *Motor Driver*

Ministerial Staff

Shri J. N. Jambudiya — *Jr. Clerk*

Supporting Staff

SSG-II

Watchmen

Shri Asiri Abu Bin Mehsan
Shri I. M. Waghela
Shri H. M. Bhint — *Messenger*

SSG-I

Shri M. K. Makvana — *Fieldman*

Rander Field Centre

Shri M. Chellappa — *Tech. Asst.*

Jamnagar Field Centre

Shri B. V. Makadia — *Jr. Tech. Asst.*

Bombay Research Centre

Technical Staff

T-4

Senior Technical Assistants

Ms. Abha Kant
Shri M. Shriram

T. I. 3

Technical Assistants

Shri K. B. Waghmare
Shri J. L. Oza

T-2

Jr. Technical Assistants
Shri C. J. Josekutty
Shri A. D. Sawant
Shri J. D. Sarang
Shri R. Dias Johny
Shri B. B. Chavan
Shri P. S. Gadankush — *Motor Driver*

T-1

Field Assistants

Shri A. Y. Mistry
Shri B. G. Kalbate
Shri Jayadev S. Hotagi
Shri Thakur Das
Shri A. Srinivasan -*Driver for Light Vehicle*

Ministerial Staff

Shri B. Vijayakumar — *Assistant*
Ms. P. V. Shanbhag — *Sr. Clerk*
Shri M. R. Wadadekar — *Sr. Clerk*
Shri Rama D. Medar — *Jr. Stenographer*
Ms. Ashlesha — *Jr. Clerk*

Supporting Staff

SSG-IV

Shri B. T. Talpade — *Lab. Attendant*
Shri R. B. Bhangare — *Fieldman*

SSG-II

Shri K. G. Tawade — *Watchman*

SSG-I

Watchmen

Shri B. D. Jangam
Shri S. M. Tandel
Shri M. P. Jadav
Ms. V. V. Kharalia — *Safaiwala*
Shri P. S. Selvi — *Messenger*
Ms. Rajani Sakharam Tambe — *Messenger*
Shri K. K. Balker — *Fieldman*

Janjira Murud Field Centre

Shri D. G. Jadhav — *Jr. Tech. Asst.*

Dahanu Field Centre

Shri S. D. Kamble — *Field Asst.*
Shri Suresh Krishnaras Kamble — *Field Asst.*

Ratnagiri Field Centre

Shri B. N. Katkar — *Jr. Tech. Asst.*
Shri David Dattatray Sawant — *Field Asst.*

Malvan Field Centre

Shri Kishore Regunath Mainkar — *Field Asst.*

Karwar Research Centre

Technical Staff

T-2

Jr. Technical Assistants

Shri C. K. Dinesh
Shri N. Chennappa Gowda

Shri T. B. Harikantra
Shri V. Varadaiah — *Motor Driver*

T-1

Field Assistants

Shri V. M. Dhareshwar
Shri U. V. Arghekar
Shri Satyanarayana V. Pai
Shri K. C. Pandurangachar
Shri M. M. Bhaskaran
Shri Narayana G. Vydya
Shri Mahadev N. Moger
Shri Arvindhan N. Bardhotkar — *Serang*

Ministerial Staff

Shri G. K. Kudalkar — *Assistant*
Shri Y. H. Gamanagatti — *Sr. Clerk*

Junior Clerks

Shri Gangadhar B. Naik
Shri Ganesh R. Nadig

Supporting Staff

SSG-IV

Shri G. M. Korar — *Fieldman*

SSG-III

Shri G. V. Naik — *Fieldman*

SSG-II

Shri M. P. Harikantra — *Oilman*
Shri M. E. Durgekar — *Lascar*

Watchmen

Shri L. K. Suvarna
Shri M. R. Kotharkar
Shri M. B. Kotharkar

SSG-I

Ms. Somi M. Harijan — *Safaiwala*
Shri Chandrakant G. Ulvekar — *Fieldman*

Watchmen

Shri Jhimmappa B. Gonda
Shri Somayya S. Gonda
Shri H. C. Naik
Shri C. N. Jeglekar — *Messenger*

Goa Field Centre

Shri Ramesh B. Kamble — *Field Asst.*
Shri Prakash C. Shetty — *Field Asst.*
Shri Subash K. Naik — *SSG-I*

Mangalore Research Centre

Technical Staff

T. I. 3

Technical Assistants

Shri G. Subramanya Bhat
Ms. Alli C. Gupta
Ms. Uma S. Bhat
Shri B. Sridharan
Shri D. Nagaraja

T-2

Jr. Technical Assistants

Shri S. Kemparaju
Shri Y. Muniyappa
Shri Maruthi Sankar Naik

T-1

Field Assistants

Shri C. Purandhara
Shri H. S. Mahadevaswamy
Shri Baramu S. Melinmani
Shri H. Vasu — *Serang*

Ministerial Staff

Shri Balakrishna Naik — *Assistant*
Shri K. M. Abdulla — *Sr. Clerk*
Shri K. Rama Naik — *Sr. Clerk*
Ms. Martha R. Mascarenhas — *Jr. Clerk*

Auxiliary Staff

Shri P. Narayana Naik — *Driver for Light vehicle*

Supporting Staff

SSG-III

Shri H. Rajaram — *Fieldman*

SSG-II

Shri U. B. Sadashiva — *Lascar*
Shri Mohan S. Puthran — *Oilman*

Watchmen

Shri G. Sampath Kumar
Shri Ramanna Sapaliga
Shri A. Keshava
Shri D. Gangadhara Gowda

SSG-I

Shri P. K. Retnakaran — *Lab. Attendant*
Ms. Padmavathy — *Safaiwala*

Bhatkal Field Centre

Shri Ganesh Bhatkal — *Field Asst.*
Shri R. Appayya Naik — *Field Asst.*
Shri C. H. Vamana Naik — *Field Asst.*

Calicut Research Centre

Technical Staff

T-5
Shri K. Nandakumaran —*Technical Officer*

T-4

Sr. Technical Assistants

Shri K. K. Balasubramanian
Shri T. Girijavallabhan
Shri K. Soman
Ms. S. Lakshmi
Ms. K. Koumudi Menon
Shri Nirmal Mathew — *Bosun*

T. I. 3

Shri K. P. Vishwanathan — *Tech. Asst.*
Ms. P. Swarnalatha — *Tech. Asst.*
Shri M. A. Vincent — *Boat Driver*
Shri P. Bhaskaran — *Sr. Deckhand*

T-2

Jr. Technical Assistants

Shri V. G. Surendranathan

Ms. V. K. Janaki
Ms. Lalitha Sekharan
Shri M. K. Gopalakrishnan — *Sr. Deckhand*
Shri K. S. Leon — *Sr. Deckhand*
Shri K. C. Devassy — *Sr. Deckhand*
Shri K. Raju — *Cook (Boat)*

T-1

Ms. K. G. Emiliyamma — *Field Assistant*

Ministerial Staff

Shri B. D. Puthran — *Assistant*
Ms. P. Subhadra — *Sr. Clerk*
Ms. C. Kamalakshi — *Sr. Clerk*
Shri R. Sreenivasan — *Jr. Clerk*
Ms. K. P. Shylaja — *Jr. Clerk*

Auxiliary Staff

Shri B. K. Velukutty — *Driver for Light Vehicle*
Shri P. Harsha Kumar — *Driver for Light Vehicle*

Supporting Staff

SSG-IV

Shri K. Janardhanan — *Fieldman*

SSG-III

Lab. Attendants

Shri V. K. Krishnankutty
Shri M. Ramadasan
Shri K. Kumaran — *Fieldman*

SSG-II

Shri K. E. J. Victor — *Watchman*
Shri K. Chekkutty — *Watchman*

SSG-I

Ms. P. Renuka — *Lab. Attendant*
Shri K. T. Mohanan — *Messenger*

Fieldmen

Shri P. Dasan
Shri T. Haridasan
Shri T. P. Renil Kumar
Shri A. Sivadasan — *Watchman*
Shri B. Raju — *Lab. Attendant*
Shri M. K. Chandran — *Safaiwala*
Shri Palaniappan — *Safaiwala*

Cannanore Field Centre

Shri K. Chandran — *Tech. Asst.*
Shri K. C. Purushothaman — *Field Asst.*

Vizhinjam Research Centre

Technical Staff

T-5

Technical Officers

Shri K. Ramachandran Nair
Shri P. S. Sadasiva Sarma
Shri R. Bhaskaran Achari
Shri Jacob Jerald Joel
Shri S. G. Vincent
Shri K. Ramakrishnan Nair

T-4

Sr. Technical Assistants

Shri T. G. Vijaya Warrier
Shri R. Vasanthakumar

T. II. 3

Shri Thomas Teles — *Bosun*

T. I. 3

Shri V. M. Alwaris — *Sr. Deckhand*
Shri A. K. Velayudhan — *Tech. Asst.*
Shri K. T. Thomas — *Tech. Asst.*

T-2

Ms. T. A. Omana — *Jr. Tech. Asst.*
Shri S. Ramachandran Nair — *Motor Driver*

Sr. Deckhands

Shri P. M. Hariharan
Shri V. P. Bensiger
Shri P. Hilary
Shri K. C. Gopalan — *Cook*

T-1

Shri K. Sasidharan Pillai — *Field Asst.*

Ministerial Staff

Senior Clerks

Shri M. Abdul Salam Sahib
Shri S. Erishikesan

Junior Clerks

Shri C. Johnson
Shri M. Reghunathan

Supporting Staff

SSG-IV

Lab. Attendants
Shri J. Anselam
Shri C. M. Rajappan
Shri V. Sasidharan Pillai

SSG-III

Shri A. Ayyappadas — *Peon*
Shri K. Chandran — *Safaiwala*

SSG-II

Watchmen

Shri V. Vishwanathan
Shri R. Madhusudhanan Nair
Shri V. Kochunarayanan Nair
Shri S. Antony — *Messenger*

SSG-I

Shri B. Prabhakaran — *Messenger*

Tuticorin Research Centre

Technical Staff

T-6

Shri A. Bastian Fernando — *Tech. Officer*

T-5

Shri R. Gurusamy — *Technical Officer*

T-4

Sr. Technical Assistants

Shri C. T. Rajan
Shri A. A. P. Mudaliar
Shri T. S. Balasubramanian
Shri P. Feroz Khan — *Bosun*

T. II. 3

Technical Assistants

Shri J. X. Rodrigo
Shri A. D. Gandhi
Shri N. Palanisamy

T. I. 3

Technical Assistants

Shri D. Sundararajan
Shri O. M. M. J. Habeeb Mohamed

Shri M. Selvaraj
Shri M. Manickaraja
Shri G. Arumugham
Shri K. Srinivasagam
Shri S. Rajapackiam

Skin Divers

Shri A. Dasman Fernando
Shri F. Soosai V. Rayan
Shri C. K. Dandapani — *Serang*

T-2

Shri M. Enose — *Jr. Tech. Asst.*
Shri P. Muthikrishnan — *Skin Diver*
Shri Xavier Mohandoss — *Motor Driver*
Shri E. Shivanandam — *Boat Cook*
Shri N. Jesuraj — *Skin Diver*

T-1

Field Assistants

Shri K. Shanmugasundaram
Shri S. Mohamed Sathakathullah
Shri R. Athipandian
Shri K. Jayabalan
Shri K Paul Sigarmony
Shri M. Antony Sagaya Moduthoms — *Driver (Boat)*
Shri R. Ponnaiah — *Electrician*
Shri K. Alagirisamy — *Motor Driver*

Deckhands

Shri D. Bosco Fernando
Shri S. Enasteen
Shri R. Arockiasamy
Shri D. Anandan

Ministerial Staff

Shri N. Rajamunisamy — *Superintendent*
Shri D. Ganajebamani — *Assistant*

Senior Clerks

Shri S. Jeyachandran
Shri B. Bavanandam
Shri S. Antony George Ratnam
Ms. S. Leelavathi — *Jr. Stenographer*

Junior Clerks

Ms. Kamala Venkataraman
Ms. S. Sarada
Ms. C. Rajeshwari

Auxiliary Staff

Shri S. K. Guruswamy — *Driver for Light Vehicle*

Supporting Staff

SSG-IV

Shri A. Francis — *Lab. Attendant*

SSG-III

Shri M. Ramadoss — *Lab. Attendant*
Shri D. Motcham — *Daftry*

SSG-II

Watchmen

Shri S. Mani
Shri M. Alfred
Shri M. Thangavelu
Shri K. Thangaraja
Shri P. Muthumalai
Shri V. Samyamuthu
Shri B. Thangaraj — *Lascar*
Ms. S. Daisy — *Safaiwala*
Shri R. Uchimahali — *Fieldman*
Shri Y. Balu — *Oilman*

SSG-1

Fieldmen

Shri W. Satyawan Neelraj
Shri K. Muthuvel
Shri P. Kandan
Shri M. Sankaran
Shri G. S. Rayappan
Shri I. Ravindran
Shri K. John James — *Gardener*
Shri P. Villiam — *Safaiwala*
Shri K. Kadarkarai — *Safaiwala*
Shri S. Alagesan — *Fieldman*
Shri I. Syed Sadiq — *Lab. Attendant*
Shri V. Muniasamy — *Lab. Attendant*

Watchmen

Shri N. Asokumar
Shri M. Shanmughavelu

Kanyakumari Field Centre

Shri N. Retnasamy — *Tech. Officer*
Shri I. P. Ebenezer — *Sr. Tech. Asst.*

Madras Research Centre

Technical Staff

T-6

Shri P. K. Mahadevan Pillai — *Field Officer*

T-5

Technical Officers

Shri S. Kandasamy
Shri M. Mohamed Sultan
Shri A. C. Sekhar

T-4

Sr. Technical Assistants

Shri S. K. Balakumar
Shri P. Ramadoss
Shri K. S. Krishnan

T. II.3

Technical Assistants

Shri S. Palanichamy
Dr. R. Thangavelu
Dr. V. Selvaraj
Shri T. N. Sukumaran — *Bosun*

T. I. 3

Technical Assistants

Shri L. Jayashankaran
Shri V. Rangacharylu
Shri H. Kader Batcha
Shri S. Subramani
Shri S. Seetharaman
Shri Hameed Batcha
Shri C. Manimaran
Shri G. Sreenivasan
Shri P. Poovannan
Shri K. Shahul Hameed
Shri G. Natarajan — *Motor Driver*

T-2

Jr. Technical Assistants

Shri S. Chandrasekhar
Shri A. Ramakrishnan
Shri P. Thirumulu
Shri S. Mohan
Shri A. Ahmed Kamal Bhasha
Shri V. S. Gopal

Motor Drivers

Shri K. Ratna Kumar
Shri K. Pandi
Shri D. Padmanabhan — *Boat Driver*
Shri Voli Mohamed — *Boat Cook*

Sr. Deckhands

Shri K. Parasuraman
Shri C. Manibal

Ministerial Staff

Assistants

Shri K. M. Karuppiah
Shri S. Mangalam

Senior Clerks

Shri S. K.Murali
Shri S. Balasubramanian
Ms. M. Parvathy
Ms. G. Abitha
Ms. Rosy Joachim — *Jr. Stenographer*

Junior Clerks

Ms. A. B. Lalitha
Ms. P. Thankaleelal

Auxiliary Staff

Shri Joseph Xavier — *Deckhand*
Shri S. Selvanidhi — *Deckhand*

Supporting Staff

SSG-IV

Shri G. Soundararajulu — *Lab. Attendant*

SSG-III

Shri M. Vellayan — *Lab. Attendant*

SSG-II

Shri R. Anandha Jyothi — *Watchman*
Shri A. Janagiraman — *Watchman*
Shri G. Chekkarapani — *Watchman*

Shri M. Ravindran — *Messenger*
Shri G. Vijayarangam — *Safaiwala*

SSG-I

Messengers

Shri M. Anbu
Shri S. Rajan

Watchmen

Shri T. Nagalingam
Shri S. Inbamani
Shri S. Yuvarajan — *Lab. Attendant*

Fieldmen

Shri V. Manoharan
Shri R. Sundar
Shri R. Vasu
Shri P. Selvaraj — *Safaiwala*
Ms. Alyali Devi — *Peon*

Cuddalore Field Centre

Shri A. Srinivasan — *Tech. Asst.*
Shri T. Dhandapani — *Tech. Asst.*
Shri M. Manivasagam — *Jr. Tech. Asst.*
Shri M. Radhakrishnan — *Jr. Tech. Asst.*

Pondicherry Field Centre

Shri L. Chidambaram — *Tech. Asst.*

Mahabalipuram Field Centre

Shri S. Manivasagam — *Sr. Tech. Asst.*

Ongole Field Centre

Shri K. V. S. Seshagiri Rao — *Tech. Officer*

Shri A. Hanimantha Rao — *Tech. Asst.*
Shri T. Chandrasekara Rao — *Tech. Asst.*
Shri G. Sudhakar — *Field Asst.*

Nellore Field Centre

Shri G. C. Lakshmaiah — *Tech. Officer*

Kovalam Field Centre

Shri S. Sankaralingam — *Jr. Tech. Asst.*

SSG-II

Shri D. Pakkiri — *Watchman*

SSG-1

Shri M. P. Chandrasekar — *Watchman*

Kakinada Research Centre

Technical Staff

T-4

Shri P. Ramalingam — *Sr. Tech. Asst.*

T. II. 3

Technical Assistants

Shri K. Ramasomuyagulu
Shri K. Dhanaraju

T-2

Shri K. Dharma Rao — *Motor Driver*
Shri Ch. Ellithathayya — *Jr. Technical Asst.*

T-1

Field Assistants

Shri T. Nageswara Rao
Shri N. Burayya
Shri P. Venkata Ramana
Shri Vasamsetty Abbulu

Ministerial Staff

Shri S. Suryanarayana Murthy — *Sr. Clerk*
Shri S. Appa Rao — *Junior Clerk*

Supporting Staff

SSG-III

Shri K. Narasimhamurty — *Lab. Attendant*

SSG-II

Shri R. V. S. Subramanyan — *Watchman*

SSG-I

Shri S. Tatabhai — *Messenger*
Shri K. Satyanarayanan — *Watchman*
Shri G. Sainyadhipathy — *Watchman*

Machilipatnam Field Centre

Shri Chandrasekhara Rao — *Tech. Asst.*

Narasapur Field Centre

Shri P. Ananda Rao — *Sr. Tech. Asst.*

Visakhapatnam Research Centre

Technical Staff

T-5

Technical Officers

Shri C. V. Seshagiri Rao
Shri M. V. Somaraju

T. II. 3

Shri K. Chittibabu — *Tech. Asst.*
Shri U. Alagamalai — *Bosun*

T. I. 3

Technical Assistants

Shri J. B. Varma
Shri S. Satya Rao
Shri M. Chandrasekhar
Shri A. K. Unnikrishnan — *Boat Cook*

T-2

Jr. Technical Assistants

Shri K. Narayana Rao
Shri M. S. Sumithrudu
Shri M. Prasad Rao
Shri P. A. Reghu — *Oilman-cum-Deckhand*

T-1

Field Assistants

Shri S. Chandrasekhar
Shri P. Achayya
Shri P. Pashupathi Rao — *Motor Driver*

Deckhands

Shri. S. Ganeshan
Shri P. Md. Abdul Moheedu

Ministerial Staff

Shri R. Appa Rao — *Assistant*
Shri Shanti Prasad — *Sr. Clerk*
Ms. B. Gowri — *Jr. Clerk*

Auxiliary Staff

Shri S. Doraipandian — *Driver for Light Vehicle*

Supporting Staff

SSG-III

Shri V. Mohana Rao — *Lab. Attendant*

SSG-II

Shri Rajan — *Peon*

Watchmen

Shri R. Kanakaraju
Shri V. Demudu
Shri P. Krishna Rao
Shri L. Appa Rao — *Messenger*

SSG-I

Shri R. Dalayya — *Safaiwala*

Contai Field Centre

Shri S. S. Dan — *Field Officer*
Shri Sapan Kumar Ghosh — *Tech. Asst.*
Shri Bijoy Krishna Burman — *Field Asst.*
Shri Swapan Kumarkar — Field Asst.
Shri Prasanta Kumar Das — SSG-I

Puri Field Centre

Shri P. V. Krishna Rao — *Jr. Tech. Asst.*
Shri Sukdev Bar — *Jr. Tech. Asst.*
Shri S. Hemasundara Rao — *Field Asst.*

Gopalpur Field Centre

Shri Satchidananda Naik — *Field Asst.*

Palasa Field Centre

Shri V. Achutha Rao — *Tech. Asst.*

Srikakulam Field Centre

Shri N. P. Chandra Kumar — *Field Asst.*

Minicoy Research Centre

Technical Staff

Shri Anasukoya — *Field Asst.*

Ministerial Staff

Ms. M. Safayabi — *Jr. Clerk*

Supporting Staff

SSG-III

Lab. Attendants

Shri C. Mohammed Koya
Shri K. Kunjukunju

SSG-II

Watchmen

Shri P. L. Koya
Shri O. Ismail
Shri N. Pookoya

Krishi Vigyan Kendra/Trainers' Training Centre

Technical Staff

Technical Officers

Shri K. Asokakumaran Unnithan — *Field Officer*
Dr. P. K. Martin Thompson — *Field Officer*
Shri K. N. Rasachandra Kartha — *Field Officer*
Shri A. N. Mohanan — *Tech. Officer*
Shri P. Radhakrishnan — *Tech. Officer*
Ms. P. Sreelatha — *Training Asst.*

T. II. 3

Shri N. B. Gopalakrishna Menon — *Bosun*

T. I. 3

Shri K. K. Prabhakaran — *Boat Cook*

T-2

Shri C. S. Xavier — *Motor Driver*
Shri P. J. Sebastian — *Motor Driver*

T-1

Shri K. K. Bose — *Boat Driver*

Ministerial Staff

Shri S. R. Narayanan — *Superintendent*
Shri P. Aithappa Naik — *Superintendent*
Shri C. Balamamundinathan — *Assistant*
Shri C. D. Manoharan — *Jr. Stenographer*
Shri N. K. Mohanan — *Jr. Clerk*

Supporting Staff

SSG-III

Fieldmen

Shri K. P. John
Shri N. K. Asokan

SSG-I

Shri K. G. Bhaskaran Nair — *Messenger*
Ms. Chinnamma Anjelo — *Safaiwala*

Regional/Research Centres of CMFRI and their Officers-in-charge

Mandapam Regional Centre of CMFRI, Marine Fisheries P. O., Mandapam Camp - 623 520, Tamil Nadu. Phone: 43 & 56	Dr. R. Marichamy, Principal Scientist
Veraval Research Centre of CMFRI, Opposite Octroi Naka, Talala Road, Veraval 362 265. Phone : 20065	Dr. Alexander Kurian, Scientist (Selection Grade)
Bombay Research Centre of CMFRI, 148, Army & Navy Building, 2nd Floor, M. G. Road, Bombay - 400 023. Phone : 245260	Dr. (Ms.) P. V. Kagwade, Principal Scientist
Karwar Research Centre of CMFRI, Post Box No. 5, Karwar, North Kanara, Karnataka. Phone : 6371	Shri G. G. Annigeri, Principal Scientist
Mangalore Research Centre of CMFRI, Post Box No. 244, Bolar, Mangalore - 575 001. Phone : 24152	Dr. P. Vedavyasa Rao, Principal Scientist
Calicut Research Centre of CMFRI, West Hill, Calicut - 673 005. Phone : 50377	Dr. V. Narayana Pillai, Principal Scientist
Vizhinjam Research Centre of CMFRI, Vizhinjam, (via) Trivandrum, Kerala, Pin 695 521. Phone : 224	Dr. P.A. Thomas, Scientist (Selection Grade)
Tuticorin Research Centre of CMFRI, 90, North Beach Road, Tuticorin - 682 001, Tamil Nadu. Phone : 20274	Dr. K. A. Narasimham, Principal Scientist

Madras Research Centre of CMFRI, 141, Marshalls Road, Egmore, Madras - 600 008. Phone : 8253299	Dr. K. Satyanarayana Rao, Principal Scientist
Kakinada Research Centre of CMFRI, Door No. 8-14-38, Red Cross Street, Gandhi Nagar, Kakinada - 533 004. Phone : 76231.	Dr. V. Sriramachandra Murthy, Scientist (Selection Grade)
Visakhapatnam Research Centre of CMFRI, Andhra University P.O., Visakhapatnam - 530 003. Phone : 55793	Dr. G. Luther, Principal Scientist
Minicoy Research Centre of CMFRI, Minicoy Island, U/T of Lakshadweep Phone : 228	Dr. V.S.K. Chennubhotla, Principal Scientist

Other units of CMFRI attached to the Headquarters, Cochin

Krishi Vigyan Kendra of CMFRI, Prawn Culture Farm, Narakkal - 682 505. Phone : 482	Dr. M.M. Thomas, Principal Scientist
Field Lab. of CMFRI, Cochin Fisheries Harbour, Thoppumpady, Cochin - 682 005. Phone : 26092	Shri K.V. Somasekharan Nair, Scientist (Selection Grade)
Vessel Management Cell of CMFRI, Fine Arts Avenue, Cochin 682 016. Phone : 369819	Shri S. Natarajan, Field Officer (T-7)

Address List of Field Centres
(Arranged alphabetically)

Alleppey Field Centre of CMFRI,
Geetha Building, Kalarcode,
Alleppey - 3, Kerala.

Bhatkal Field Centre of CMFRI,
Room No. 72, Municipal Rest House,
Near Bus Stand, Bhatkal,
North Kanara, Karnataka.

Cannanore Field Centre of CMFRI,
Ayikara Police Station Building,
Cannanore-17, Kerala.

Chavakkad Field Centre of CMFRI,
Chavakkad P.O.,
Trichur District, Kerala.

Contai Field Centre of CMFRI,
Thanapukurpar, P.O. Contai,
Midnapur District, West Bengal.
Phone : 254

Cuddalore Field Centre of CMFRI,
No. 106, Irusappa Chetty Street,
Cuddalore Port, South Arcot District,
Tamil Nadu - 607 003.

Dahanu Field Centre of CMFRI,
Kirtane Bungalow, Mangailwada,
Dahanu, Thana District, Maharashtra.

Gopalpur Field Centre of CMFRI,
Door No. 44, Big Street,
Gopalpur-on-sea P.O.,
Ganjam District, Orissa.

Goa Field Centre of CMFRI,
Daulat, III Floor, 18th June Road,
Panaji, Goa.
Phone : 5995

Jamnagar Field Centre of CMFRI,
Milan Chambers, Khodiyar Colony,
Aerodrome Road, Jamnagar-361 006,
Gujarat.

Janjira Murud Field Centre of CMFRI,
14/3, Bazar Peth Road, Ground Floor,
Janjira Murud - 402 401,
Raigad District, Maharashtra.

Kanyakumari Field Centre of CMFRI,
Kanyakumari, Tamil Nadu.

Kovalam Field Laboratory of CMFRI,
Kovalam, Chengulpet District,
Tamil Nadu.
Phone : 52

Machilipatnam Field Centre of CMFRI,
17/299, Sidimbi Agraharam,
Chilakalapudi P. O.,
Machilipatnam- 521 002,
Andhra Pradesh.

Mahabalipuram Field Centre of CMFRI,
Mahabalipuram, Tamil Nadu.

Malvan Field Centre of CMFRI,
Municipal House No. 2799/3,
Dawoolwada, Malvan - 416 606,
Sindhudurga District, Maharashtra.

Narasapur Field Centre of CMFRI,
Door No. 9-2-64,
Church Road,
Narasapur - 534 275,
West Godavari District,
Andhra Pradesh.

Nagapattinam Field Centre of CMFRI,
C/o Inspector of Fisheries,
Salt Road, Nagapattinam - 611 001,
Thanjavur Dist., Tamil Nadu.

Nellore Field Centre of CMFRI,
Room No. 14, Municipal Building,
New A.C. Bubba Reddy Statue,
Weyyalakalava Street, Nellore - 1,
Andhra Pradesh.

Ongole Field Centre of CMFRI,
No. 49, A.P. Housing Colony,
Manidipakam, Ongole - 523 002,
Prakasam District,
Andhra Pradesh.

Palasa Field Centre of CMFRI,
K.T. Road (Near Ravi Electricals),
Palasa, Srikakulam District,
Andhra Pradesh.

Pattukottai Field Centre of CMFRI,
Room No. 23, Periaswamy Building,
187/A, Big Bazar Street,
Pattukottai - 614 601, Tanjore Dist.,
Tamil Nadu.

Pondicherry Field Centre of CMFRI,
C/o. Office of the Dy. Director of
Fisheries (HQ),
49 B, V.O.C. Street,
Pondicherry - 605 001.

Puri Field Centre of CMFRI,
L.I.G. 45, Shrikshetra colony,
Water Works Road,
Puri - 752 002, Orissa.

Quilon Field Centre of CMFRI,
Municipal Stadium Building,
Ward No. VIII, Door No. 737,
Quilon, Kerala.

Rander Field Centre of CMFRI,
II Floor, "Devikrupa",
3/213, Randari Ward, Rander,
Surat - 395 005, Gujarat.

Ratnagiri Field Centre of CMFRI,
Building No. 3615, Devchand Nivas,
Lower Line, Ratnagiri,
Maharashtra.

Srikakulam Field Centre of CMFRI,
Door No. 8-15-68, Ring Road,
Near Head Post Office,
Srikakulam - 532 000,
Andhra Pradesh.

ENGAGEMENTS

Dr. P. S. B. R. James, Director, CMFRI attended the following:

Inaugural function of the Penaeid Prawn Hatchery at Mopla Bay and the Seminar in connection with it at Cannanore, 6 April '90.

National Co-ordination Committee Meeting of the Second Indian Fisheries Forum at Mangalore, 27-28 May '90.

Inaugurated the Seminar on Phaeophyceae at Presidency College, Madras, 7 June '90.

ICAR Co-ordination Committee Meeting to finalise the Annual Cruise Programmes of FORV *Sagar Sampada* at New Delhi, 21 June '90.

Review Meeting of the VIII Five Year Plan proposal at New Delhi, 7-8 August '90.

Meeting with Director General, ICAR at New Delhi, 24 August '90.

Central School Management Committee Meeting at Mandapam Camp, 18 September '90.

Visited the different sites in and around Nellore for setting up College of Fisheries 17-19 August '90.

ICAR Scientific Panel for Fisheries, 9-10 October '90.

Working group on revalidation of potential yield estimate of fishery resources in the EEZ of India at Fishery Survey of India, Bombay, 16-17 November '90.

Meeting of the Top Management Programme on Deep Sea Fishery Enterprises at Visakhapatnam, 19 November '90.

NACA Regional Committee Meeting at Bangkok, 10-13 January '91.

ICAR Regional Committee No. VIII Meeting at Trivandrum, 13-14 February '91.

Inaugural and valedictory function of the International Training Course on Pearl Culture under FAO/UNDP Regional Seafarming Project Tuticorin, 1 February '91 and 28 February '91 respectively.

Remote Sensing Project Evaluation Committee Meeting at Hyderabad, 13 March '91.

Dr. A. V. S. Murty, Principal Scientist participated and presented his poem 'Viswageethi' in the Kavisammelan in connection with the National Seminar on Official Language at Cochin, 18-21 June '90.

Dr. K. A. Narasimham, Principal Scientist attended the first meeting of the High Level Environmental Monitoring Committee held at Tuticorin Port Trust, 21 April '90.

Dr. D. B. James, Scientist (S. G.) attended the meeting on *Beche-de-mer* convened by the Director, Marine Products Export Development Authority at Tuticorin, 23 June '90.

Shri R. Marichamy, Principal Scientist, **Dr. C. P. Gopinathan**, **Dr. D. B. James, Dr. M. Rajamani** and **Dr. H. M. Kasim**, Scientists (S. G.) attended the second Indian Fisheries Forum of the Asian Fisheries Society held at Mangalore 27-31 May '90.

Dr. V. S. Kakati, Scientist (S. G.) attended the Managing Committee Meeting and Technical Sub-committee meeting of BFDA (Govt. of Karnataka) at Karwar.

Dr. N. Kaliaperumal, Scientist (S. G.) participated in the workshop on 'Algal Products', 4-6June'90and Seminar on 'Phaeophyceae in India', at Presidency College, Madras,7 June '90.

Shri D. B. S. Sehara, Scientist (S. G.) and **Dr. Manpal Kaur Sanhotra**, Scientist participated in the Hindi Workshop held in connection with the National Seminar on Official Langauge at Cochin, 18-21 June '90.

Shri P. K. Asokan, Scientist and **Shri M. Abdul Nizar**, Jr. Tech. Asst. attended the Summer School on Marine Acoustic Systems and Instrumentation at NPOL, Cochin sponsored by Department of Electronics from 14-24 May '90.

Dr. P. Nammalwar, Scientist (S. G.) participated in the National Seminar on Recent Advances in Coastal Marine Sciences at Anna University, Madras,9-11 July '90.

Dr. A. Noble, Principal Scientist, **Dr. A. D. Diwan**, Scientist S-3, **Shri Bikas Chandra Mohapatra** and **Shri V. Bhaskaran,** Senior Research Fellows, participated in the National Symposium on 'Environmental pollutants and resources of land and water', organised by the Marathwada University, Aurangabad.

Dr. A. D. Diwan, Scientist S-3 participated in the National Workshop on 'Organisational Management in Educational Institutes' at NAARM, Hyderabad, 19-23 November '90.

Dr. A. D. Diwan, Scientist S-3 attended the first Hindi National Workshop on "Samudra Vigyan Ki Upalabdhiyam aur Agami Yojanayem" organised by Dept. of Ocean Development, Govt. of India at NIO, Goa, 3 December '90.

Shri R. Marichamy, Officer-in-charge, Mandapam and Technical Assistants (Survey) of Mandapam Regional Centre of CMFRI participated in the Regional/Zonal Workshop of F.R.A. Division held at Madras 18-21 December '90.

Dr. Alexander Kurian, Officer-in-charge, Veraval and Technical Assistants (Survey), Veraval Research Centre of CMFRI attended the Zonal Workshop of Survey Staff held at Bombay Research Centre, 18-21 December '90.

The Survey Staff of Calicut Research Centre of CMFRI participated in the Zonal Workshop, Calicut, 18-21 December '90.

Dr. A. P. Lipton, Scientist (S. G.) attended the National Symposium on New Horizons in Freshwater Aquaculture, Kausalyaganga, Bhubaneshwar, 23-25 January '91.

Shri K. N. Kurup and **Dr. N. G. K. Pillai**, Scientists (S. G.) participated in the National Seminar on Fishery Resources of Kerala organised by the Kerala Sastra Sahitya Parishad at Cochin, 23 February '91.

Dr. N. Kaliaperumal, Scientist (S. G.) and **Shri S. Kalimuthu**, Sr. Technical Assistant, participated in the All India Symposium on 'Algae in Human Affairs and Environment' at Poondi, 21-23 February '91.

Dr. N. Kaliaperumal, Scientist (S. G.) and **Shri S. Kalimuthu**, Sr. Technical Assistant participated in the National Symposium on 'Marine Algae - Current Status and Emerging Trends' at Bhavnagar, Gujarat, 21-23 March '91.

Dr. M. M. Thomas, Chief Training Organiser and Officer-in- charge, KVK/TTC of CMFRI, Narakkal attended the following:

Local Management Committe meeting of KVK Mitranikethan, 19 April '90.

Local Management Committee meeting of KVK, Pattambi, 5 June '90.

Review meeting of ICAR TOT projects of zone VIII at KVK, UPASI, Coonoor, 24-26 July '90.

National Workshop on Planning Agricultural Extension Training, New Delhi, 27-29 November '90.

Review & Planning meeting of CTO's and Zonal Co-ordinators at Pusa, New Delhi, 26-28 December '90.

Monthly Workshops of Kerala State Agricultural Extension Programme (Ernakulam District) in May, June, July, September, October and December '90; February and March1991.

VISITORS

Cochin

Cambodian delegates comprising of Dr. Mok Mareth, Honourable Vice Minister of Agriculture; Mr. Li Kim Han, Director General of Fisheries, Mr. Touch Seang Tana, Administrator of Fisheries, State of Cambodia and Mr. M. C. Aereira, Agronomist, CIDSE Programme in Cambodia.

Mr. E. E. Lodzeni, Administrative Officer, O/o the President & Cabinet, Malawi.

Mr. W. C. A. Mkandawire, Administrative Officer, O/o the President & Cabinet, Malawi.

Mr. Almawossen Habtie, Planning & Programming Expert, Dept. of Planning & Programming, Ethiopia.

Mr. Seife Ayele, Junior Expert, National Committee for Central Planning, Ethiopia.

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